Tropical Products Institute

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An Inquiry into the Feasibility of Producing Particle Board from Groundnut Husks in India

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by

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Foreword

I wish to thank all those who assisted in the preparation of this report, especially institutions, firms and individuals in India who helped so obligingly and efficiently in the collection of information. Their names are given in Appendix I.

Much is also owed to colleagues at Tropical Products Institute and members of British firms who advised on technical points, and to my fellow industrial economists who most patiently helped with the calculations.

Penelope A Mars
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Objective

The purpose of this survey was to ascertain the economic feasibility of the establishment in India of a plant to demonstrate the manufacture of particle board from groundnut husks, a process which has been developed at the Tropical Products Institute.

Terms of Reference

There were no formal terms of reference; however, the following points emerged from discussion as being the main goals of the survey:

1. To find a suitable location
2. To estimate costs of production
3. To reach a conclusion whether, in view of the estimated cost, the product could be marketed successfully
4. To decide whether conditions in India are likely to lead to a reasonably widespread adoption of the process, should the demonstration plant prove to be successful

The Survey

The survey in India lasted from 9th December until 3rd February, and included visits in New Delhi, Andhra Pradesh, Mysore, Bombay, Gujarat, Maharashtra and Madhya Pradesh. The attached appendix gives the exact itinerary and a list of persons and places visited.

Nearly all the time spent in New Delhi, and part of that spent in Bombay, was devoted to the collection of macro-economic data, while much of the time spent in other places was devoted to reviewing and collecting data on sites. A number of people interested in the project were interviewed in Bombay.

General Findings

It was established at an early stage that the market for particle board is national rather than local, which was a welcome simplifying factor, as was the co-operative attitude of Indian authorities and individuals, which greatly facilitated the collection of information in the course of a very congested tour. Great interest was shown by the groundnut industry.

Another feature of the market is that owing to the recent recession in India the physical shortage of wood had not yet had much impact on the price of timbers competing with particle board. The former remain cheaper. As a result, existing wood particle board firms were working at about 18 per cent of their capacity. It was also found that veneered particle board is more acceptable than the plain variety which the plant

is at present designed to produce. The report deals primarily with unveneered particle board.

Other points which emerged were that husks are not purely a waste material but have a value which is higher in more industrialised areas, and that urea formaldehyde (U.F.) resin is much more expensive than in Europe partly owing to the heavy excise duty, higher prices of raw materials and also probably owing to small-scale production.

In contrast to these adverse factors, it was found that some of the existing wood particle board manufacturers were making U.F. resin in "captive plants" claiming that the cost was lower than that of purchased resin. Attempts were made to collect information on this process while in India.

Analysis of Findings

Altogether, seven possible sites were visited and adequate costing data were collected at five of these, four of the latter being large-scale groundnut processing plants decorticating a large proportion of the nuts used so that part of the necessary supply of husks would be under their control. On the basis of preliminary costings two of the five sites were eliminated and of the remaining three, two appeared to be suitable for a demonstration plant.

The fact that at the lowest cost site the cost of purchased resin at Rs 5,506 per metric ton (delivered) amounted to over 55 per cent of total ex-factory costs of making particle board underlines the importance of an accurate costing for U.F. resin made on site. In view of its great divergence from the price of purchased U.F. resin, it was hard to accept the figure of Rs 3,000 per metric ton which was quoted in India as the cost of making U.F. resin in a captive plant. Excise duty is known to be included in the figure for purchased resin: its inclusion in the second figure was implied but uncertain. Since April, therefore, attempts were made to get from India, and especially from an interested firm, further information on factors determining the cost of small scale resin manufacture. This caused considerable delay. Although complete information was never obtained it was finally possible with the help of TPI technologists to confirm that the cost of making U.F. resin, *excluding excise duty*, is in the region of Rs 3,000 per metric ton.

The data collected on the market for particle board were not sufficiently detailed to form the basis for projections. However, assuming that economic recovery in India continues and per caput incomes increase, it seems probable that increasing demand for wood products in conjunction with the inelastic supply of timber may drive wood prices to a level that would enable particle board, especially ground nut shell particle board, to compete with sawn wood within, say, five years.

Using factor cost data collected at the site with lowest costs and a comparatively low price for wood as raw material, a cost comparison was made between particle boards made from groundnut husks and from wood. It was assumed that import duty was paid on the plant (which would apply in a commercial setting) that excise duty at the official rate of 36 per cent was paid on the resin made in a captive plant, and that the plant operated on single shift at 70 per cent efficiency to produce 1,066 metric tons per year.

Including depreciation, the husk particle board cost Rs 1.24 per sq.ft. and the wood board cost Rs 1.52 per sq.ft. or Rs 1.30 per sq.ft. excluding depreciation. These figures may be compared with a current wholesale price of Rs 1.40 per sq.ft. for wood particle board of comparable specification.

Assuming a life of 15 years, that the husk particle board would sell at Rs 1.40 per sq.ft. and that other conditions were the same as those stated in the preceding paragraph, discounted cash flow analysis yielded an internal rate of return of 3.4 per cent. This is below the level of 5 per cent required by ODM for a project to be considered worth further investigation. If two shifts were assumed to be worked, the output being 2,132 metric tons, cost per square foot falls to Rs 1.12 per sq.ft. and the internal rate of return rises to over 14 per cent, which is well above the 8 per cent level at which ODM considers a project suitable. At this level of output, if the price were put below the Rs 1.40 charged for wood particle board, the project could still yield 8 per cent. The exact price that would yield 8 per cent has not been calculated, but is probably in the region of Rs 1.30. A lower price may be necessitated by the somewhat inferior properties of husk particle board.

Conclusions

Since the price per sq.ft. of Rs 1.40, on which the preceding analysis pivots, is well above the level of Rs 0.75 to 0.80 at which unveneered groundnut husk particle board is considered likely to sell freely in India under present conditions, (the price of comparable sawn wood, mango, being from Rs 6 to 8 per cubic foot), it is extremely unlikely that quantities of husk particle board of the order of 1,000 to 2,000 metric tons can be sold at the present time at a price which would cover costs, and it is therefore not possible to recommend the immediate establishment of the demonstration plant at either of the suitable sites. However, it is considered probable that, within a few years the prices of competing sawn wood and of wood for making particle board will rise so that husk particle board will be on a better competitive footing.(1)

Consequently India should remain under consideration as a possible venue for the demonstration plant. India appears to be better suited for a demonstration plant than other countries because her output of groundnuts is three or four times that of the next country in size, namely Nigeria, so that the process has a chance of being used extensively there. Finally, since the product is unlikely to compete with wood particle board in international trade (which is in any case limited to about 11 per cent of world production owing to its low value-to-volume ratio), the potentially large and sophisticated urban market of India, already acquainted with particle board, is an advantageous feature which distinguishes her from all other groundnut producing countries.

The successful marketing of this new and untested product cannot be expected to follow automatically from the emergence of a wood shortage but would have to be promoted. In this connection it is relevant to quote the following opinion of the Head of the Research and Development Department of ICI:

"The technological research required to develop a new product is faster in its results and much less expensive than the commercial research into marketing applications that is essential if the product is to be economically viable".[1]

Further technical and economic investigation is considered justifiable.

Firstly, although the samples of board have been tested in accordance with British Standard tests and appear to be of adequate quality in certain respects and inferior in others, their performance in use under tropical conditions cannot be predicted accurately from the results of these tests,

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(1) The imminence of the wood shortage may be revealed by a forthcoming UNDP report entitled "Pre-Investment Survey of Forest Resources in India", which was in preparation in July 1969.

1 Speech at Industrial Marketing Research Assocn.Conference "Packinging: Financial Times Survey". Financial Times 10th Sept. 1969. 15.

and since facilities for making groundnut husk particle board exist in the form of excess capacity in the wood particle board industry, it is likely that sufficient husk particle board could be made in India to enable performance and market tests to be carried out.

Secondly, it is necessary to proceed beyond the assumption which underlies this report ... namely that the particle board would be produced without any surface finish except sanding, whereas board finished with veneer or laminate is much more popular in India. In view of this, it has already been decided at the Tropical Products Institute to attempt to develop cheap improved surfaces, or decorative finishes for the board. Successful work on these lines might enable husk particle board to compete with particle board veneered with costly wood or plastic laminate. In addition it is claimed by an Indian firm that resin used for veneered particle board is exempt from excise duty because excise duty is levied on the finished product. This point would have to be substantiated.

Finally, it must be stated that the problem of assessing the performance of the board in use and its acceptability on the market as a distinct product would have to be tackled ultimately in any other country that might be considered as a venue for the demonstration plant, and since India is known to have facilities which would make this technical and commercial assessment practicable, as well as reasonably promising long-term market prospects, this opportunity should be taken so that an early decision could be taken whether to sustain interest in groundnut husk particle board or to abandon or pigeon-hole the project.

Recommendations

1. Arrangements should immediately be made to manufacture particle board from groundnut husks on existing plant in India.

2. Performance tests for various uses of the board, such as wallboard, flush doors and furniture should be devised and applied under controlled conditions in India, preferably with parallel tests on competing materials such as sawn wood, wood particle board and plywood. It might be possible to enlist the help of the Indian Plywood Industries Research Association in India in this work. Since the monsoon season, which is said to be particularly unfavourable to particle board, starts in April and reaches its peak from June to August, no time should be lost in arranging for these tests.

3. Samples of board could also be issued for use in Government construction projects, and tested in normal use. This would take longer than tests mentioned previously.

4. The cheap and attractive finishes which are currently being tried out at the Tropical Products Institute, could be applied to the board made in India. Carefully planned market tests should then be made using samples of coated and uncoated sanded board.

5. The project should then be re-evaluated in the light of more precise knowledge about the market, in order to reach a final conclusion as to its viability.

6. Meanwhile the complete report which is almost ready for publication should be circulated to interested firms in India so that they may draw their own conclusions based on local knowledge concerning the feasibility of the project. In this connection it must be stated that some of the decorticating firms are likely to be exporting oil seed cake and may therefore have access to foreign exchange.

   One firm has already expressed interest in buying a plant.

7. If, in fact, resin used in coated particle board is subject to excise duty, an approach could be made to the Indian Government to secure a reduction in the excise duty on resin in particle board made with husks, which although not a waste product, is usually of less commercial value than the wood used for making particle board.

CHAPTER I

INTRODUCTION

General

One of the functions of the Tropical Products Institute is to develop new processes from the utilisation of tropical waste materials, and the process for making particle board out of groundnut husks, (for which machinery was devised by Gardners of Gloucester Limited) is an example of this activity.

The process for making particle board out of groundnut husks was investigated in a preliminary report[1] completed in September 1967, which indicated that given the data available in this country or on factor costs and markets, reasonably good prospects for this process exist in India, the world's largest producer of groundnuts. Since reliable information on certain points was lacking, the proviso was made that a detailed investigation should be made on the spot by an economist.

Terms of Reference

Although the actual survey was the subject of much discussion, no formal terms of reference were drawn up. The following points are those which emerged from the discussion as being the main objectives of the survey.

1. To find a suitable location.

2. To estimate costs of production.

3. To reach a conclusion whether in view of the estimated cost, the product could be marketed successfully.

4. To decide whether conditions in India are likely to guarantee a reasonably widespread adoption of the process, should the demonstration plant be successful.

Conduct of the Survey

In the 1967 Report, location was considered state by state having regard to the probable supply of groundnut husks, the absolute and proportionate level of urbanised population likely to provide markets and the availability of wood, and bagasse which is another board-making material. This review resulted in the choice of Madras State as the first state to be investigated mainly because the two large population centres of Madras and Bangalore (State capital of Mysore) lie within 100 miles of the main groundnut-growing areas of North and South Arcot, Gujarat, Maharashtra and Andhra Pradesh were designated as next in order of eligibility. Table 1 of this report shows the annual production of groundnuts in the main producing states.

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(1) "Memorandum on the Economic Aspects of a Plant to Produce Particle Board from Groundnut Husks, with Special Reference to India". By M.J. Edmonds, Tropical Products Institute, September 1967.

When the present survey was being considered, priority was initially given to Gujarat and Maharashtra because estimated income per caput in these states in 1960-1961 was higher than in Madras[2] and also because the number of inquiries received by the Tropical Products Institute from Madras was very small compared with the numbers received from the other two states. However, arrangements were made from England to visit Hyderabad and Bangalore in Southern India in case any locations in that areas should be identified.

The itinerary between the major towns, which was proposed before the start of the survey was substantially the actual one recorded in Appendix 1. It was thought that the most suitable location would be an existing groundnut processing firm having under its control a supply of husks constituting a large proportion of the quantity required for the factory, and it was hoped that at least two site investigations would be made, and as it was then believed that transport costs would make it necessary to find markets for particle board relatively close to the site, and it was thought that up to four days should be devoted to investigating each site. A large number of trade associations and other organisations including those of states were approached in advance and requested to help to identify suitable sites. The response was considerable and this resulted in a larger number of sites being investigated in a much shorter time - half a day or less. This change of approach was facilitated by the fact that the market for particle board in India was found in fact to be national rather than local, and had the advantage that a broader view was obtained of the general situation relating to the supply and price levels of husks. A disadvantage was that some of the interviews listed in Appendix 1 were of little value to the project, because it had not been possible to weed out irrelevant inquiries.

It is of some interest that no requests for further information about the project were received from Madras. A possible reason is that in that state, hand decortication may still be extensively practised.[3]

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(2) Estimates of State Income. By National Council of Applied Economic Research, New Delhi, July, 1967, 57.

(3) "Report on the Price Spread of Groundnuts and Groundnut Oil in India". Directorate of Marketing and Inspection, Ministry of Food and Agriculture, Nagpur, 1964.

CHAPTER 2

THE LOCATIONS

General

Fairly detailed surveys were made at five locations, of which four were owned by large firms engaged in decortication among other activities; the fifth would involve a new undertaking possibly with the participation of the local State Government. Table 1 shows the production of groundnuts in the main producing states from 1963-64 to 1967-68. Two of the locations were in Andhra Pradesh, and one each in Gujarat, Maharashtra and Mysore.

Less detailed surveys were made at two sites belonging to decorticating firms in Gujarat and Indore. The first of these places Manavadar, is mentioned only on page 5 of this report, where the stated prices of husks and coal are given. Apart from the fact that the data were not as complete as in the case of the first five, these two locations were not given fuller treatment in this report, since they were for various reasons considered less suitable than others.

The selection of the locations visited was largely dependent on the way in which the survey was organised. The majority of decorticating firms visited had written in to one of the organisations which had sent out circular-letters. In Gujarat, the tour and contacts were mainly arranged by the State Industries Commission, and the one site visited in Maharashtra belonged to an organisation which had been corresponding with the Tropical Products Institute about the possibility of making particle board from groundnut husks for a number of years. In the majority of cases, interest was shown by firms situated in the States where groundnuts are most plentiful (see Table 1).

Apart from the cost structure which will be dealt with in Chapter 3, the following locational factors have been considered in the course of the survey and in this report.

1. Availability of husks
2. Climate in relation to the storage conditions of husks
3. Distance from major urban markets
4. Electricity supplies, existing and planned
5. Location of existing particle board factories
6. Supplies of wood in the region.
7. General impression of undertaking
8. Political stability of region

Brief notes on just six of these items are given in this chapter while the last two items are dealt with in Appendix III. The six main locations dealt with in this report are designated as follows in the order in which they were visited.

Site 1.	Kurnool	Andhra Pradesh
Site 2.	Adoni	Andhra Pradesh
Site 3.	Davengere	Mysore

Site 4.	Jamnagar	Gujarat
Site 5.	Manavadar	Gujarat
Site 6.	Latur	Maharashtra

Availability and quality of husks

The availability of husks has two relevant aspects; whether the quantity controlled by the firm or available in the neighbourhood is adequate to keep the factory running, and the price at which the husks can be obtained.

All the sites except Jamnagar are in the possession of decorticating firms, also engaged in other activities such as solvent extraction, soap manufacture, and the assembly of oil cans. All of these claimed to produce approximately enough husks to run one shift (2,000 metric tons).

At site 1, near Kurnool, the total capacity of the decorticators was said to be 40,000 metric tons of pods per annum, yielding about 10,000 metric tons of husks per annum. However, it was claimed that owing to the difficulty of disposing of the husks, current production of husks was at the rate of only 2,250 metric tons per annum.

In the case of Kurnool, Davengere, Jamnagar and Latur, written evidence was produced as to the probable availability of large supplies of husks in the neighbourhood. "At the district headquarters of Kurnool, there are 8 firms which decorticate 30,000 tons of groundnuts per annum"(1). "The estimated arrivals of groundnuts in Davengere market is 45,000 tonnes. Recovery of husk will be 14,000 tonnes".(2) According to an official table, the average annual production of groundnuts in Jamnagar district from 1964-1965 to 1966-1967 was 177,900 metric tons. Assuming that 25 per cent of the weight is husk, the amount produced would be 44,475 metric tons(3). An official map showed the production of husks in an area about 65 km. in diameter, in which Latur lies, to be 48,180 metric tons(4). Clearly, at all these places enough husks to run the plant on 3 shifts, which would require about 6,000 metric tons per annum, are likely to be physically available.

The distribution of the harvest through the year is of some importance, because it affects the quantity of husks to be stored and the range of price fluctuations, which is likely to be less, the longer the harvest period.

Indications of the sowing and harvest periods for groundnuts in the States of Andhra Pradesh, Gujarat and Maharashtra are shown in Figures I, 2 and 3 together with climatic data.

At Kurnool, it was stated that the groundnut season starts at the end of October and that most groundnuts are harvested between November and February. The irrigated harvest starts in April. It was stated that groundnuts are delivered at the factory for 200 days. Factory records showed that decortication was carried on throughout the year at Kurnool. The moisture content appeared to be lower during the monsoon months.

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(1) Letter from Regional Office Oilseeds Development, Hyderabad 19.11.68. See Appendix I.

(2) Appendix I, item 29

(3) Appendix I, item 58

(4) Appendix I, item 36

According to the published source, there is also an irrigated groundnut crop in Gujarat. However, this has been omitted from figure I because it was stated that in the whole district of Saurashtra (the pensinsula part of Gujarat which is the main groundnut area), there is only one harvest, (during November)(5). The absence of an irrigated crop was attributed to the cold climate in winter(6). It was stated in Jamnagar that groundnuts arrive in the markets during December, January and February and are stored for the remainder of the year, that supplies of husks would be available for 8 to 10 months, and that production would continue through the monsoon.(7)

At Latur, it was stated that rain-fed groundnuts arrive at the factory from November to March, while the irrigated supply arrives from May to mid-June. This factory also runs through the monsoon.

There is evidence that the Government is concentrating its efforts to improve the Indian groundnut crop in Andhra Pradesh, which should influence the supply of husks in that state in future(8).

The stated prices at which husks were said to be available vary greatly and since they are used largely as industrial fuel depend largely on the price of coal in the area. Table I below shows the stated price of purchased husks and coal at six sites together with an indication of the size of the nearest town.

Table I

Husk and Coal Prices, Winter, 1968-69 and Population, 1961

Prices in Rupees per metric ton

	Andhra Pradesh		Mysore	Gujarat		Maharashtra
	Site 1 Kurnool	Site 2 Adoni	Site 3 Davengere	Site 4 Jamnagar	Site 5 Manavadar	Site 6 Latur
Husks	10	25	45	50	20	40
Coal	60	40	65	110	100	90
Population	100,895	<100,000	<100,000	148,572	<100,000	<100,000

Transport costs constitute a large proportion of the cost of coal to a factory. Thus, at Latur it was stated that Grade B coal containing 14 to 22 per cent of ash cost Rs.42 per metric ton at Sangareni colliery on the border of Andhra Pradesh and Madhya Pradesh. Rail transport to Latur cost Rs.36 per ton, the remainder of the cost of Rs.90 per ton being accounted for by short-weight.

The map attached to this report shows the position of collieries and of the sites, and it is obvious that coal prices are positively correlated with distance from sites.

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(5) Appendix I, item 64

(6) Appendix I, item 89

(7) Appendix I, item 58

(8) Appendix I, item 16
and "Commercial Crops, Annual Programme, 1968-69", Crops Division, Ministry of Food and Agriculture, New Delhi, 1968.

The exact calorific values of husks and Indian coal are not known. However, the following statement has been published. "About 3 maunds of shell are equivalent to about 1 maund of coal"(9). Except at Kurnool and Manavadar, the ratio between the prices of husks and coal exceeds one third. These sites were both in remote rural areas with little industry in the vicinity and at Kurnool there was said to be difficulty in disposing of surplus husks. That in most places the price of husks is higher than one third of the price of coal must be due partly to the demand for husks arising outside the factories where they are produced. The only domestic uses for husks mentioned were for parboiling rice and heating water in the south.

Industrial uses apart from fuel, enumerated mainly in Gujarat, were for brickmaking, lime-burning and for packing between oil tins in transit. Although husks require more stoking labour than coal, they are preferred at decorticating factories, because they can count on the supply whereas coal deliveries may be uncertain.

Except at two sites, the quality of the husks appeared to be good. They were in all cases stored in the open. It was noticed that a layer about six inches thick at the top of the pile was discoloured as a result of being soaked during the monsoon. Underneath, the husks appeared undamaged. Two samples of husks from Adoni and Latur which were thought to be unsuitable were brought back and assessed at the Tropical Products Institute. They were found to be of good quality, the fines content passing through a BS 22 mesh sieve being below 7.5 per cent in both cases.

Climate in relation to the storage conditions for husks

As the mat or mixture of husks and other raw materials should not contain more than 20 per cent moisture, when it enters the press, the husks themselves should not contain more than 12 per cent moisture, since 8 per cent of water is added with the resin emulsion. The climate, especially rainfall and relative humidity, in the area of the factory is thus important.

Apart from the data for rainfall at Kurnool, which is local, all the climatic information in the figures was derived from observations published for the nearest meteorological stations. The firms visited were not in a position to provide records of relative humidity throughout the day.

Only at one place, Junagadh, which is situated inland in Gujarat were husks seen which were rendered useless by the monsoon. This place has 35 to 40 inches of rain per annum, as a result of being situated close to a mountain. This can be compared with about 20 inches of rain at Jamnagar.

On the basis of available information it is not possible to decide definitely whether in any normal circumstances the husks would become so wet that it would be necessary to provide a mechanical drier, or even whether it would be necessary to shelter them under a roof during the monsoon. It is conceivable that both might be necessary, if husks under cover are able to take up moisture from the atmosphere. It is also conceivable that neither might be necessary, in view of the undamaged appearance of husks that had been stored in the open during the monsoon, compared with that of the outer discoloured layer that had been soaked. The manager at Kurnool thought the husks could be sheltered at negligible cost by covering them with tarpaulins, while at Latur, it was stated (and also apparent) that there is plenty of storage space in go-downs.

(9) "Report on the Marketing of Groundnuts in India (2nd ed.). Directorate of Marketing and Inspection, Ministry of Food and Agriculture, Government of India, Delhi, Calcutta, 1953, 80.

If nuts in husks are stored in go-downs at Kurnool before decortication during the monsoon period, presumably the husks produced at that time could be stored in the space vacated by the nuts. As the site at Jamnagar was not in the hands of an existing firm, there were no go-downs there.

It is not possible to infer from Figure I the maximum amount to be stored or the storage period. These amounts would be likely to be lowest at Kurnool, in view of the short gap between harvests which occurs at the time of the monsoon.

The problems of the moisture content and storage of husk would have to be studied on site at the time of the monsoon.

The only conclusion that can be derived from Figure I is that Jamnagar is climatically a less suitable site than Kurnool or Latur, although this need not necessarily be an excluding factor.

Distance from major urban markets

A point that emerged at an early stage in the survey was that the market for the particle board currently manufactured in India is national rather than local, and that it is sold at a uniform price including transport costs, in the larger towns of India(10). When comparing the sites in terms of total production costs, it was decided to assume that the output of the factory would be distributed between Bombay, New Delhi, Madras, Bangalore, Hyderabad and Ahmedabad in proportion to the population of those cities and to assume that it would be transported by rail. The former assumption is reasonable, since uniformity of price in different major urban markets excludes distance as a limiting factor and the second is reasonable because the prices of wood particle board are quoted as follows: "F.O.R. (free on rail) Destination for all stations in India. .....The rates are for despatches by ordinary goods train. In case materials are despatched by quick transport service, passenger train or lorry transport, the difference between the freight thereof and ordinary goods train freight shall be borne by the consignee"(11). Thus the distribution costs for groundnut particle board are computed on the same basis as those for wood particle board, the price of which enters this assessment.

Calcutta was omitted from the list of markets because of its great distance from the sites and because it was not mentioned as a possible market, whereas the comparable towns of Delhi and Bombay were known to be markets for particle board manufactured in the regions visited.

The calculation of rail freight costs on particle board is shown in Table 11 for each of the five sites. The cost of handling and transport from the factory to railhead has been omitted as a separate item.

It appears from the Table 11 that the sites at Kurnool and Adoni have the lowest transport costs for the product on the stated assumptions.

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(10) Appendix I, items 15 and 28

(11) Price schedules of Particle Boards India Limited, and of Central India Board Products.

Electricity Supplies

Although the electricity supply in Andhra Pradesh was said to be poor because it is largely "hydro" and depends on the monsoon,[12] the general impression is that of the three selected sites (see below, page 10) Kurnool has a reliable supply because it is in a less industrialised region than the other sites and is linked with a thermal power station[13] There is also on the premises a 1,000 kw. Brown Boveri generator which was used until recently and is kept in working order. The maximum demand is 1,950 KVA[14], so that the generator would not be adequate to supply the whole factory in the event of a power cut.

Latur is connected with both thermal and hydro supplies through a grid system. There is a serious shortage of electric power in India resulting in power cuts and much was heard of this in Gujarat and Maharashtra. The supply in Andhra Pradesh and Maharashtra was stated to conform with the machinery makers' requirements; namely 440 volts, 3 phase, 50 cycles. This point was not checked at Jamnagar. However, there is no reason to expect the supply to be different.

Printed information was collected about existing supplies and distribution networks and plans for future improvements in supply. There was little point in reviewing this as the shortages seem likely to persist.

Location of existing particle board factories and supplies of wood

The wood particle board factories believed to be in production at December 1968 are shown below in Table II. The locations of these wood particle board plants have been entered on the map.

According to statistics relating to areas "reported for land utilisation purposes",[15] 20 per cent of the total area so defined in India consists of forests. The forest percentages for the states under review are: Andhra Pradesh, 22 per cent: Gujarat, 6 per cent, Maharashtra, 18 per cent, and Mysore 14 per cent. Some prices of firewood, which is often used as a raw material for particle board are given in Table IV on p. 20 below. These prices do not appear to reflect relative shortages.

When this survey was being planned, it was thought that the location of existing wood particle board factories, and of forests which might provide raw material for further wood particle board factories, was important since they would affect the competitive situation.

However, since little particle board appears to be sold close to the factories, these two factors cease to be very important.

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(12) Appendix I, item 16

(13) Appendix I item 21

(14) Letter of 28 March, 1969.

(15) Statistical Abstract of the Indian Union, 1967
Central Statistical Organisation, Government of India, New Delhi, 1968, 34.

Table II

Particle Board Units by Indian States and Capacity

No.	State	Name and address of the firm	Location of plant	Capacity metric tons
	a	b	c	d
1.	Uttar Pradesh	M/s Plywood Products, Sitapur Uttar Pradesh	Sitapur	6,000
2.		M/s Nuboard Mfg. Co., Port House, Dr. D.M. Road, Bombay	Bareilly	7,200
3.	Kerala	M/s Bharat Plywood & Timber Products, Cannanore.	Cannanore	2,500
4.	Mysore	M/s Indian Plywood Mfg. Co. 9, Wallace Street, Fort, Bombay-1.	Dendeli	7,000
5.		M/s Mysore Chipboards Ltd., 2909, Temple Road, Veri Villas Mohalla, Mysore-2.	Mysore	7,500
6.	Madras	M/s Madras Chipboards Ltd., Shri Bhavan, Kumarawaany Raja Road, Rajapalayam, Madras.	Rajapalayam	1,700
7.	Madhya Pradesh	Central India Board Products Ltd., 9, Wallace Street, Fort, Bombay-1.	Itarsi	7,000
8.	Mahara-	M/s Particle Boards (I) Ltd., Khetan Bhavan, 188, Jamahedji Tata Road, Bombay-1.	Bombay	6,000
			Total	44,900

Source:- Directorate General of Technical Development Ministry of Industrial Development, New Delhi.

Conclusion

On the basis of locational factors considered in this chapter, the best site appears to be Kurnool in Andhra Pradesh.

CHAPTER 3

COSTS OF PRODUCTION AT SELECTED LOCATIONS

General

In order to restrict the size of this report it was decided to limit the presentation of costings to three of the sites which were thought to be most suitable for demonstration plants for reasons which are stated in Appendix III.* These are Site 1, Kurnool, Site 4, Jamnagar and Site 6, Latur. (Preliminary costings were also done for Adoni and Davengere and the totals were found to lie between those for Kurnool and Latur).

The costings for the three selected locations are shown in Tables 4 to 7. Table 2 shows capital items involving sterling costs and Table 3 shows estimated capital cost for project at sites 1, 4 and 6 including local costs.

Many of the items in Tables 4 to 7 are self-explanatory. Further explanations of the underlying assumptions and some of the items in the tables are given in the following sections.

Market prices, rather than opportunity costs or accounting prices have been used, since this report is concerned with commercial profitability.

The Assumptions

The specification for the board and assumptions relating to working conditions are stated at the top of each table.

Initially, throughout the calculation, minimal assumptions were made, because in the course of the survey, it became increasingly obvious that conditions in India at present are not very favourable towards the establishment of this industry, and it was considered that the case against it would be established clearly if the assessment showed an unsatisfactory result on favourable assumptions.

Thus, three shift working was assumed in the first instance because this would yield the lowest cost attainable by groundnut particle board for comparison with existing wood particle board. The production rate of 15 boards per hour is at the average rate specified by the machinery maker, and, compared with a maximum of 17.5, it implies an operating efficiency of 86 per cent, which is very high for a developing country,[1] especially in view of probable electricity cuts.

No allowance has been made for transport of raw materials from rail head or other local source to the factory or for transport of boards to the rail head. Local state taxation has been omitted from the costs. (New undertakings would be subject to a tax holiday in this respect). However, the costs of purchased raw materials other than husks include the 3 per cent Federal Sales tax.

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(1) "Tender and Specification". By Gardners of Gloucester, 4.

* Appendix III is confidential and is not included in copies of this report for circulation.

The cost of selling the board through agents was put at 15 per cent on the ex factory cost (row 31 of Tables 4 to 7) although some firms put the cost at from 17 to 20 per cent.(2) No allowance was made for packaging, which is necessary if the board is sent by rail.

For Site 1 at Kurnool, which had the lowest three shift costs, costs for single shift working, under special assumptions are shown in column d.

In the capital cost tables, no allowance has been made for storage or drying of husks since the cost of storage might be negligible and the necessity for a drier is not proved. The estimated inclusive on site cost of the drier would be £5,000. It was not possible to estimate the cost of handling and inland carriage of the plant in India. However a reasonable allowance of 10 per cent for unforeseen costs (3) is shown in row 9 of Table 3. At Site 1 this amounts to Rs.221,604 or £12,311.

Although the normal import duty on machinery might be modified in special circumstances, it was strongly contended in India that the import duty would have to be paid,(4) and although there was some difference of opinion as to the rate it was finally assumed to be 27½ per cent *ad valorem* on the c.i.f. value of machinery.(5) Import duty at this rate has been entered in row 6 of Table 3. However in Tables, 4, 5 and 6 and also in column c. of table 7 depreciation is calculated net of import duty. Similarly, it was considered that the expenses of a technical manager sent out to run the plant for the first nine months (row 17 of Table 2) and a member of the Tropical Products Institute Staff employed there for six months (row 16 of Table 2) should be similarly excluded.

At the suggestion of a member of the firm concerned, import duty on machinery and spare parts is included and is taken into account in calculating depreciation in column d. of Table 7. Totals for capital costs are given for the three main sites in Table 3 both including (row 10) and excluding (row 11) the above items.

Raw Material Costs

Raw material costs are shown in rows 1 to 6 of each table. The cost of husks has been discussed in Chapter 2. The cost of resin will be dealt with below.

The quantities assumed to be used, allowing for waste, are indicated in Column b. There is a safety margin allowing for interruption of supplies, spoilage and fines in the allowance of 50 per cent extra on husks. Otherwise, 10 per cent is assumed to be wasted in trimming boards.

All prices except those of husks and insecticide have been calculated to include central sales tax at 3 per cent. In the case of insecticide, the product was stated to be available locally at prices inclusive of the 3 per cent tax. Rail freights on raw materials are shown in Table 10.

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(2) Appendix I, items 22 and 29

(3) "Industrial Development: A Guide for Accelerating Economic Growth" by M. D. Bryce. McGraw-Hill Book Company Inc., Kogakusha Company Ltd., Tokyo, 1960, 126.

(4) Appendix I, item 50.

(5) Rate stated by Public Relations Officer, Excise and Land Customs Collectorate, New Delhi. Telephone conversation on 30.1.69. According to "Indian Customs and Central Excise Tariff", Department of Commercial Intelligence and Statistics, Calcutta, Government of India, this rate applies to woodworking machinery and spare parts.

It was assumed that ammonium chloride is used to make hardener for the resin. At Rs 2,250 per ton, it is cheaper than the hardener prepared by CIBA. The insecticide is the sodium salt of pentachlorophenol, which is manufactured by Sardesai Brothers at Billimora, Gujarat, and is sold at prices varying between Rs 7 and Rs 12 depending on the market. The ex factory price for paraffin wax of standard grade, with a melting point between 135°F. and 141°F. as quoted by Burmah Shell, Ballard Estate, Bombay was Rs 1,239 per ton including excise. To this was added 3 per cent federal sales tax.

The Cost of Resin

At least four firms in India manufacture urea-formaldehyde (UF) resin for sale. These are

Allied Resins and Chemicals,
Calcutta.

Ciba of India, (CIBA)
Bombay. (Factory at Bulsar, Gujarat)

Nuchem Plastics Limited,
Faridabad.

Reichold Chemicals India Limited,
Madras.

Of these firms at least two, namely CIBA and Nuchem Plastics make UF resin in powder form. Allied Resins and Chemicals, Reichold Chemicals India and CIBA make liquid UF resin, although the latter firm said that they normally make the solid form.

Before going to India, the writer was told by a member of the Borden Chemical Company (UK) Ltd. that liquid UF resin has a shelf life of 1½ months in India, while solid resin keeps for 12 months. Since goods dispatched by rail may take more than 1½ months to reach their destination, solid resin has an advantage. The net ex-factory price of solid resin (Aerolite CB) quoted by CIBA for quantities of 6 metric tons and above was Rs 3,730. Including 36 per cent excise duty, packing and surcharge, the price per metric ton would be Rs 5,438. Nuchem Plastics quoted a price of Rs 4,900 including excise duty for Prescol (UF) resin in powder form, which is equivalent to Rs 3,603 per metric ton ex-factory. Reichold Chemicals India quoted an ex-works price of Rs 2,300 per metric ton for Foramine 21-0.19 UF resin in solution having a solid content of at least 60 per cent. On a solids basis this is equivalent to Rs 3,833 per metric ton which is higher than the CIBA and Nuchem prices. It was decided to assume that resin in solid form would be supplied by the nearest factory to the sites, namely CIBA.

The ex-factory price of solid UF resin made by CIBA expressed in sterling per metric ton, is £207, which can be compared with a price of £94 per metric ton c.i.f. Bombay for imported CIBA UF resin.(6) The high cost of resin made in India is mainly due to the high cost of the raw materials which are also made in India. Formaldehyde is made by the oxidation of methanol (methyl alcohol). Methanol is now made as well as urea by the Fertiliser Corporation of India at Trombay near Bombay. Urea which is also made by Gujarat Fertiliser costs Rs 883 per metric ton. Formaldehyde which

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(6) See Appendix I, Item 39

is made at the Atul Drughouse plant at Kandlar, north of Bombay on a small scale of about 12,000 metric tons per annum, costs from Rs.1,300 to Rs.1,400 per ton. The price of methanol was formerly Rs.1,500 per metric ton and has fallen to Rs.950, compared with an f.o.b. price of Rs.400.[7] According to another source,[8] the price of methanol is unlikely to fall below Rs.700 per metric ton which is approximately the f.o.b. price plus import duty, at 60 per cent *ad valorem*.[9]

No significant fall in the ex-factory price of UF resin was anticipated by anyone with whom it was discussed. The high excise duty is a further cause of the high cost of resin to particle board factories. The manufacture of resin in India started in 1960 and an excise duty was first imposed in 1964 at an effective *ad valorem* rate of 24 per cent. In 1967 the rate was increased to 36 per cent. Efforts are being made to secure a reduction of this duty, but as the plywood industry can sustain it (see Table 12), there is little hope that such a change will take place in the near future.

From rows 2 and 29 of Table 4 it can be seen that the cost of purchased resin constitutes about half the total ex-factory cost of the board. Apparently promising experiments are being made at the Indian Plywood Industries Research Association to make resins suitable for particle board from lignite and from wattle bark. The former was described as a multivariate phenol costing Rs 900 per metric ton ex-factory. The wattle resin cost Rs.1,900 per metric ton ex-factory. However, there is no evidence that these resins are being used commercially in the Indian particle board industry,[10] and to use them in the TPI process would require further development work.

Some of the existing particle board factories are known to make their own resin at a reduced cost. There was some difference of opinion as to whether such resin would be subject to excise duty; the official view being that it would be charged, with the implication that the Treasury has some discretion.[11]

After a preliminary version of this report had been completed, in a letter dated September 12th, the Maharashtra State Co-operative Bank, which is connected with Site 4, made a statement implying that the excise duty may not be charged in the case of veneered particle board. This report deals primarily with unveneered particle board. However, the possibility of making veneered groundnut husk particle board in India is considered later, and this point could be checked.

Attempts were made to find the cost of making resin in a "captive" plant. According to one source[12]: "The investment envisaged in machinery and equipment is Rs 25,000, for the desired resin capacity. The cost of resin in solution will be around Rs.3,000/tonne. This compares favourably with the present cost of resin solids excluding Rs.5,000/tonne".

In view of its great divergence from the price of purchased UF resin, it was hard to accept the figure of Rs.3,000 per metric ton quoted above. Excise duty is known to be included in the figure for purchased resin: its inclusion in the second figure was implied but uncertain. Consequently attempts were made to obtain from India further information on factors determining the cost of small scale resin manufacture. This has caused

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(7) Appendix I, item 44
(8) Appendix I, item 91
(9) Indian Customs and Central Excise Tariff in Operation on 30th June, 1966 loc. cit. 70
(10) Appendix I, item 39
(11) Appendix I, item 91
(12) Appendix I, item 71

considerable delay. Although complete information was never obtained it was finally possible with the help of TPI technologists to confirm that the cost of making UF resin, excluding excise duty, is about Rs.3.100 per metric ton. This figure includes no profit. The price of Rs.3.730 per metric ton charged by CIBA is likely to include a profit element, also probably certain overheads such as management and advertising not included in the estimated cost of making resin in a "captive" plant. The calculation is shown in Table 22.

It was assumed that the plant would be made in India at a price quoted by a British firm for plant made in Britain. This estimate shown in row 1 agreed fairly well with some Indian estimates for plant costs. Very precise estimates for raw material costs, shown in rows 3 to 6 were obtained from the manufacturers via the British High Commission in Bombay. It may be seen that raw material costs constitute a very high proportion of total operating costs.

In accordance with the official view, it was assumed that excise duty at 36 per cent *ad valorem* is charged on resin made in a captive plant. This gives an inclusive cost per ton of Rs.4.272 for Site 1 (single shift working). This figure is used in column d. of Tables 7 and 8 and in column c. of Table 9. The corresponding cost for treble shift working is Rs.4.254 per ton.

Personnel Costs

The machinery makers specified that there should be 1 overseer (foreman) and 1 service engineer per shift, and 1 technical manager. In addition they specified two semi-skilled and 16 unskilled operatives per shift including 2 saw operators and 2 boiler feed operatives also employed as cleaners. At Sites 1 and 6, where steam is assumed to be provided by the parent factory, (see row 16 of Tables 4, 6 and 7) 1 boiler operator per shift has been excluded. The other is retained for cleaning. The saw operators, who are also optional are retained and assumed to help the manager with quality control.

Also since the parent companies are equipped with workshops and engineering staff, only 1 service engineer is provided for three shifts.

At Site 4, where the factory is assumed to be set up independently, the cost of a boiler is included in the capital costs (row 4 of Table 3) and an extra boiler man in the operating costs (row 11 of Table 5). It is assumed that 1 service engineer is required for each shift.

Depreciation

In India tax is allowed on depreciation calculated on the diminishing balance.(13) On three shifts the appropriate rate for particle board was taken to be 20 per cent on plant. For buildings a rate of 5 per cent was taken regardless of shift working, although double this percentage is allowed for tax purposes (see Table 20, column b.) In Tables 4 to 7 approximately equivalent straight-line rates had to be used. For three shifts, it is assumed that the plant is written off in 10 years and in 15 years for one shift. The building is assumed to last 45 years in both cases. The approximately equivalent straight-line rates, which are 10 per cent, $6^2/3$ per cent and 2.2 per cent respectively on the initial value are shown in column e. of Tables 4 to 7.

(13) "Taxes and Incentives: A Guide for Investors", Indian Investment Centre, New Delhi, 1968, 34, 82-91.

Working Capital

When estimating the working capital required for a project in a developing country, three months operating costs is a normal allowance.(14) However, "sometimes, it takes more than two months for goods to be transported from one end of India to another, even in wagon loads".(15) Four month's operating costs have thus been used to estimate working capital shown in rows 13 and 14 of Table 3.

As explained below on page 15, it is assumed that at site 1, the particle board can be delivered by lorry at the same cost as by rail, but without the delay so that the working capital could be calculated on the basis of two months operating costs. This has been done in rows 15 to 18 of Table 3.

Comparison of Costs at Three Sites

The main difference between the costings shown in Tables 4, 5 and 6 lies in the assumed mode of operation. At sites 1 (Andhra Pradesh) and 6 (Maharashtra), the plant is assumed to be operated by and situated in the precincts of an existing firm engaged in groundnut decortication and oil extraction. In the case of site 4 (Gujarat) the plant is assumed to be operated by a joint venture consisting of the Gujarat Industrial Investment Corporation which would provide a loan of Rs. 1 million and an association of oil millers which would supply land for the plant and equity capital to the extent of Rs. 1 million. The remaining capital would be subscribed by the public.

This arrangement would mean that the entire supply of husk would have to be purchased, capital costs would include that of a boiler (row 4 of Table 5), while operating costs would include the wages of a boilerman and the cost of oil fuel. In the other two cases, steam would be supplied at cost by the parent factory. Interest on loan capital has to be included in the overhead costs for Site 4. Further reference is made to this arrangement in Appendix III.

In column c. of all the costing tables, it has been assumed that the product is delivered to the dealer by rail (row 30), involving the calculation of working capital on the basis of four months operating costs instead of the more normal period of three months.

A member of a possible prospective parent firm at Site 1 stated that the cost of truck delivery by their own vehicles would be equivalent to the cost of rail delivery i.e. about Rs.50 per ton for the actual distances involved and that taking into account the firm's warehousing arrangements in market towns as well as the greater speed of truck delivery, the turnover period could be reduced from four to two months.(16) Production costs in Table 4 have therefore been recalculated in column d. with two changes in the assumptions, namely, that resin can be made in a captive plant in the factory (working three shifts) at a cost of Rs.4,254 per metric ton instead of Rs.5,438 and that working capital is based on two months

(14) "Industrial Development. A Guide for Accelerating Economic Growth" loc. cit., 2300

(15) "Marketing Particle Boards in Developing Countries with Special Reference to India". By H.K. Vissanji, FAO Committee on Wood Based Panel Products. Second Session, Rome, November 1968, FO. WPP/68/7/23

(16) Another firm stated its road transport costs to be Rs.40 per ton for 400 km. and Rs.60 per ton for 800 km. The calculated average distance per ton of board delivered for Site 1 is 772 km. Costs per ton for 772 km. might in fact be lower at Site 1 than those quoted by the other firm because this firm is in a good position to arrange return loads.

operating costs (row 14 of Table 3). Row 37 of Table 4 shows that these changes bring about a very substantial reduction in average unit costs. If the unit costs shown in row 37 of column c. in Tables 4 to 6 are compared, it emerges that for the two similar sites 1 and 6, unit costs are so close together at Rs.1.19 and Rs.1.22 that the difference may not be significant. The low cost of husk at Site 1 is evidently offset by higher labour and energy charges. Unit cost at Site 4, shown in row 38, is considerably higher at Rs.1.30 per sq. ft.

For this site, total costs of raw materials are the highest of the three under review, owing to the high cost of husk in an industrialised area and high rail transport costs (see map and Table 10), which also affect delivery costs (see Table 11). On the other hand if total costs for personnel and services are added together, the total for site 4 is lower than for the other two. Table I on page , shows that at Manavadar the south coast of Gujarat husks cost only Rs.20 per metric ton instead of Rs.50 in an industrialised town. If the factory could be sited at Manavadar and sea transport to Bombay substituted for more expensive rail transport, a unit cost lower than Rs.1.30 per sq. ft. might be achieved in Gujarat.

Since costs are lowest at Site I in Andhra Pradesh, and since this site has other locational advantages, further analysis of costs and of profitability has been applied to this site and is set out in chapter 5.

CHAPTER 4

THE MARKET FOR PARTICLE BOARD IN INDIA[1]

Although there are differences in the qualities of groundnut husk particle board and of comparable wood particle board, which will be discussed later in this chapter, the two types of particle board may be regarded as substitutes, and it was thought that the best way to evaluate the market for groundnut husk particle board during the short time available in India would be to examine the existing particle board industry. This chapter deals with the current situation of the particle board industry in India, a comparison of the available data on the price of particle board with those of its substitutes in various uses and some comments on possible future trends with particular reference to groundnut husk particle board, the properties of which are also discussed.

The Present Situation of the Indian Particle Board Industry

In 1961, the FAO predicted a rapidly expanding demand for particle board in South Asia (Ceylon, India, Nepal and Pakistan). The demand for materials for fibre board and particle board was expected to expand from an annual average of 1,000 cubic metres of round wood in 1953-1955 to 100,000 cubic metres of round wood in 1975. It was expected that the expansion of industrial production and a rise in national income would bring about spectacular increases in the demand for plywood and veneers, although shortage of suitable timbers would, in cases where substitution is possible, favour the use of fibre board and particle board, which can be manufactured from wood of less exacting specifications.[2]

The same source predicted a shortage of both industrial and fuel wood in India in the passages quoted below:

> "In India, which accounted for 6.5 million m^3 of the 7.6 million m^3 of industrial wood felled in South Asia in 1953-1955, no increase at all in production is expected, because a rise from the more intensive exploitation of the forests in use, and from bringing hitherto inaccessible forests under management, will be offset by a great drop in yield from trees outside the forests, which at present account for between one-third and one-half of the industrial wood felled. Applied to India, the estimated 230 per cent rise in demand for industrial wood in South Asia would bring demand up to 15.4 million m^3, which is nearly 9 million m^3 more than the forecast of production."

> "In India, where most of the fuelwood at present comes from land not classed as forest, production is estimated to drop from the annual 1953-1955 level of 71 million m^3 to as little as 47 million m^3 by 1975, while demand during this period is expected to rise from 71 million m^3 to about 200 million m^3. Admittedly this increase allows for some substitution of dung by wood as a domestic fuel; but even without any such conversion the 47 million m^3 would meet only slightly more than half of the likely demand.[3]"

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(1) The international market for particle board is dealt with briefly below on pages

(2) Timber Trends and Prospects in the Asia-Pacific Region, UNFAO, Geneva, 1961, 45.

(3) Ibid, 84, 85.

Table 12, which gives statistics for the output of wood based panel products, should be looked at in the context of the FAO predictions quoted above. Columns i. and j. give the actual annual growth rates and the growth rates predicted by the FAO for the various products. It may be seen that the output of plywood, and especially commercial plywood which competes in some uses with particle board increased at a higher rate from 1961 to 1967 than the rate of increase in demand forecasted by the FAO, while the converse is true with regard to fibre board, insulation board and particle board.

Row 5 of Table 12 shows the output of particle board from 1961 to 1967 in metric tons. An output below 8,000 metric tons in recent years may be compared with the stated total capacity of 44,900 metric tons (Table II on page 9). The writer was told, in January 1969, that of the firms shown in Table II, Plywood Products at Sitapur, Bharat Plywood at Cannanore and Particle Boards Limited at Bombay had ceased production, although the plant belonging to Particle Boards Limited might be transferred to the edge of the forest in Rajasthan, where timber supplies are cheaper than in Bombay; so that production may now be below the 1967 level of 7,815 metric tons. Although output was expanding in the early years shown in the table and production was expected to reach 15,000 metric tons by the end of the third plan in 1966(4) the later figures in row 5 of Table 12 reflect the general retardation of economic growth resulting from crop failures in 1965 and 1966, and the particular effect of the excise duty imposed in 1964 and raised from 24 to 36 per cent in 1967, which raised costs. There is thus considerable excess capacity in the wood particle board industry at the present time.

The relative prosperity of the commercial plywood industry can be explained partly by the lower sensitivity of plywood to high resin prices and partly by the failure of the expected wood shortage to materialise, so that ply logs are less scarce than was expected. The following statement was made by a British plywood manufacturer: "Making the assumption that both 12 mm. and 9 mm. plywood are made as 5-ply, then I calculate that for plywood weighing 30 lb./cu. ft., the percentage of U.F. (resin) would be about 4 per cent and 5.3 per cent respectively".(5) Thus, plywood can be made using about half the amount of U.F. resin required for particle board.

As there are no reliable figures for the current output of wood, the absence of acute scarcity in recent years can only be inferred. The draft outline for the fourth five year plan puts the current output of industrial wood in 1965-66 at 8 million cubic metres,(6) probably making some estimate for production in addition to that from forest areas, which was stated to be 6.3 million cubic metres in 1964-65, while firewood, including wood used for charcoal amounted to 13.5 million cubic metres.(7)

A more accurate estimate of the total current supply of industrial wood may be included in the report of a pre-investment survey of forest resources in certain regions, carried out in India as an UNDPFAO project, which is expected to appear in 1969.(8)

The general impression received in the course of the feasibility survey was that while industrial wood is physically scarce in India in keeping with the fact that (in a country which ranks fifth in population density among

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(4) "Forest Industries in India: Plywood, Fibre Boards, Particle Boards". Bulletin No. 1 (Revised), Federation of Plywood Industry, New Delhi, 1st January, 1967, 14.

(5) Letter from Factories Direction Ltd., Pine End Works, Lydney, Gloucester, 3rd June, 1969.

(6) "Fourth Five Year Plan: A Draft Outline". Government of India Planning Commission, 1966, 205.

(7) "Progress Report by the Ministry of Food, Agriculture, Community Development & Co-operation (Department of Agriculture) of India". Prepared for the Commonwealth Forestry Conference 1968, New Delhi, 1968, 9.

(8) Appendix I, item 9.

developing countries) the total forest area is only 22 per cent., compared with a world average of 33 per cent.,(9) wood is relatively plentiful in relation to the low effective demand. Some statistical confirmation for this view is given below.

Table 13 gives wholesale prices of three types of industrial wood per cu. ft. from 1961 to 1968. Teak and shisham (*Dalbergia Catifolia* Roxb.) are multi-purpose woods used for construction, furniture, turnery, veneers and plywood. Teak is used in heavy packing cases and shisham for agricultural implements. Sal (*Shorea robusta* Gaertn. f.) is used only for constructional purposes.(10) The prices shown in these tables are used in compiling the official index numbers of wholesale prices of agricultural commodities. The index, (for which 1952-3 = 100), has risen from 123.8 in 1960-61 to 220.9 in 1967-68, an increase of 78 per cent. It can be seen by inspecting the tables that the prices of teak and sal have not risen at as higher rate as the general index in which food stuffs predominate. However, the price of shisham has nearly doubled, the abrupt rise in 1968 suggesting that after a steep rise in the price of teak during 1966 and 1967, demand was switched to its close substitute, shisham. The latter interpretation is in accordance with the view of a timber merchant, who stated independently that wood prices had been kept down by the utilization of successively lower-priced substitutes.(11)

The National Building Organisation, who state that roughly 45 per cent of the timber supply is used in construction have produced "broad estimates" relating to investment in housing and building, which indicate that failure in this sector may have reduced pressure on the supply of industrial wood. These are shown below.

Table III

Investment on Housing and Building in India in Relation to Total Investment in the Economy

Rs million

Plan	Total Investment in the economy	Investment in housing	Investment in other building	Total of c + d	Percentage of investment in		
					housing to total	other to total	f + g to total
a	b	c	d	e	f	g	h
First 1951-56	33.6	11.5	5.5	17.0	34	16	50
Second 1956-61	67.5	13.0	6.6	19.6	19	10	29
Third 1961-66	104.0	15.5	7.8	23.3	15	7	22

Source "Assessment of Building Material Requirements for the new Fourth Five Year Plan".

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(9) "Progress Report 1960-65". Loc. cit., introduction.

(10) "Indian Standard Classification of Commercial Timbers and Their Zonal Distribution (Revised)". I S : 399-1963, Indian Standards Institution, New Delhi, 1964, passim.

(11) Appendix I, item 48.

Lack of upward pressure from the building industry on the prices of timbers such as teak and shisham which are used directly in construction as well as for making plywood, may have facilitated the unexpected expansion in the output of commercial plywood in India shown in row 3 of table 12.

Row 4 of Table 12 shows that the output of fibre board and insulation board has been much greater than that of particle board. The progress of this industry, which refutes the charge of consumer conservatism, is likely to be due to the relative cheapness of the product, insulation board being particle board of low density (400 kg./m.^{3}) and usually of small thickness, and fibre board being made without resin by a different process involving the reduction of the material to fibres and the use of higher pressure than is the case with particle board. Both insulation board and fibre board may be made of bagasse.

The supply and price of fuel wood is another factor relevant to the current position of the wood particle board industry since fuel wood was stated to be the principal raw material used for this industry.(12)

The increased demand projected by the FAO and quoted on page 17 was largely dependent on the assumptions that requirements of domestic fuel wood would increase in proportion to population growth, and that the use of dung would increase by only 10 per cent above the 1955 level, the excess demand being diverted to wood. Minor reductions were expected to arise from increased efficiency in fuel use and by the substitution of commercial fuel for wood.

Unfortunately there are no reliable statistics relating to the current output of fuel wood, nor is it possible to evaluate the effect on demand of the above factors.

The Forestry Officers of Andhra Pradesh, Gujarat and Maharashtra, provided information, which is shown below in Table IV.

Table IV

Prices of Fuel Wood from State Forests

Rupees

	Gujarat	Prices at Government timber depots, 1969	
		Reserved forests	Protected forests
1	Price per 100 stacked ft.3	32	27
2	Estimated price per metric ton(13)	23	20
	Maharashtra	Prices at unspecified point	
		1959	1969
3	Prices per metric ton	50	75
	Andhra Pradesh	Price of firewood available locally	
			1969
4	Price per metric ton		60 to 80

(12) Appendix I, items 9 and 48.

(13) 1968 Yearbook of Forest Products. UNFAO, Rome, 1968, 151. The conversion factors used were: 100 stacked ft.^{3} of fuel wood = 1.841 m.^{3} and 1.33 m.^{3} = 1 m. ton (broad leaved). The volume figures are "solid volume without bark".

It is common in India for prices of fuel wood to be quoted per weight ton, although "tropical hard woods are found to contain 20 to 120 per cent moisture in the form received in the factory",(14) so that the weight ton is not an accurate measure. Though, they are thus not strictly comparable the figures in rows 2 and 3 of Table IV are roughly in accordance with other evidence collected in India. Firewood from Rampur, about 70 km. from the factory of Nuboard Manufacturing Company at Bareilly, was said to cost R.30 or 40 per ton.(15) A timber merchant stated that particle board manufacturers use firewood and waste supplied by the Government forests costing not more than Rs.30 per weight ton containing 60 per cent moisture.(16) Allowing for some margins and transport cost these figures are of the same order as those in row 2 of Table IV.

A particle board firm in South India was using soft wood cores, plywood waste and waste from match factories costing from R.45 to 50 per ton. A civil servant, well acquainted with the industry gave a general figure for the cost of wood delivered to particle board factories as R.50 per ton.(17)

Firewood prices are likely to be high in Maharashtra, owing to the large requirements of Bombay.

Both the Gujarat and Maharashtra figures are connected with evidence of scarcity of firewood as a raw material for particle board. The ratio of forest area to total area of Gujarat is below the average, and the Chief Conservator of Forests for Gujarat State, who supplied the prices, stated that large quantities of firewood are imported from outside the State and that no surplus firewood would be available for a particle board factory.(18)

Particle Boards of India Limited, which was set up in Bombay to take advantage of the market, derived its raw material in the form of firewood costing Rs.70 per ton, from the Maharashtra forests. This firm closed down in 1968, owing, it was said, to the high cost of resin.(19) As it was rumoured that the plant was to be removed to the edge of the forest in Rajasthan where wood is cheap,(20) the high cost of wood in Bombay is likely to have been an additional cause of the firm's failure.

It should be noted that the available data on prices of firewood and wood waste as raw materials for particle board show a large area of overlap with the prices of husks shown in Table 1.

The particle board industry has actively campaigned to persuade the Government to remedy its unfavourable situation. One of its main achievements is the agreement of the Defence Authorities and the Central and State Public Works Department to accept and specify the use of particle board in all building works.(21) These specifications, which were in force in 1966, may help to sustain demand, since the State plays an important role in construction and building activities. However, the writer was told by the engineer in charge of the construction of an important new town, that no particle board would be used there.

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(14) "Manufacture of Chipboard from Tropical Hardwoods" By Dr. V.B. Kumar, (Assam Hardboards Limited) in "Particle board Manufacture and Application", L. Mitlin, ed., Pressmedia Limited, Sevenoaks, 1968, 43.

(15) Appendix I, items 41 and 42.

(16) Appendix I, item 48.

(17) Appendix I, item 7.

(18) Letter dated 9th June, 1969.

(19) Appendix I, item 15.

(20) Appendix I, item 37.

(21) "Marketing Particle Boards in Developing Countries with Special Reference to India". Loc. cit.

Another achievement is the exemption of plain particle board from excise duty. In order to give the industry some compensation for the heavy excise duty on resin, the excise duty on plain particle board which was said to be 7 per cent *ad valorem*, was removed in 1968.(22) Veneered particle board(23) and plywood(24) are still subject to excise duty. The excise duty on particle board was 0.65 mm. decorative veneer on one side and 1 mm. commercial veneer on the other, was said to be Rs.0.15 per sq. ft. and that for board with 1 mm. commercial veneer on both sides was Rs.0.065 per sq. ft. The effect of this relief on the sales of plain particle board has evidently not been very large. According to a Delhi timber merchant, the price of 12 mm. plywood with commercial veneer on both sides was R.1.50 per sq. ft., including 15 paisa excise duty.

It may be concluded that difficulties on the supply side especially the high price of resin and to some extent the high price of fuel wood have been most important in preventing the expansion in the output of particle board in India which was predicted by the FAO. On the demand side the most important factor has been competition from industrial wood which is still relatively plentiful and from other panel products, especially plywood, which has superior properties and a price advantage in some uses.

Properties of TPI Particle Board

Since the object of the following review of relevant price data is to assess the possible competitive position of TPI particle board, it is necessary to take into account the properties of the latter. Table 9 gives data relating to the performance of TPI particle board in comparison with the Indian standards for medium density wood particle board. The TPI results, shown in columns d. to g. were derived from British standard tests which differ somewhat from the Indian ones. On this point, the general opinion of a technologist is that the results are closer to the Indian than to the British Standards. At a later stage, further tests using Indian methods, should be made.

For dimensional stability during immersion in water and thermal conductivity, the TPI board performed better than the Indian standard. The advantage of low thermal conductivity in India is obvious, while the lower swelling capacity might be an advantage if the particle board is used for partitions, since particle board in this use has to be capable of withstanding the frequent washing of floors practised in India.(25)

According to an expert, water absorbtion on immersion "bears no relation to any board properties important in the final product".(26)

The test results for minimum modulus of rupture are closer to the Indian standard than are those for minimum tensile strength perpendicular to surface. As the Indian methods of test for modulus of rupture appear to be less rigorous than the British, the TPI board might have adequate load-bearing properties in certain uses. It is stated in this connection that, "in the case of furniture .... it is worth bearing in mind that veneering can considerably strengthen the raw board, and that weaker, lower density boards, are sometimes more resistant to warping".(27)

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(22) Appendix I, items 3, 5 and 7.

(23) Appendix I, items 82 and 91.

(24) Appendix I, item 98.

(25) Appendix I, item 43.

(26) "Board Properties and Quality Control". By L. Mitlin in "Particle Board Manufacture and Application". op. cit., 116.

(27) Loc. cit.

Elsewhere, it is stated that - "In most cases furniture components are veneered and this will materially affect bending strength, dependent on the strength of the veneer, and may well more than double it".(27a)

Since "tensile strength is .... related to resistance to screw withdrawal from the edge of the board",(28) the TPI board would be less suited to furniture making unless other methods of joining can be devised. The writer was shown a desk in which particle board was joined by nut and bolt; however, this was not an edge join.

This review of the test results suggests that TPI particle board might find a limited market in India in uses where good load-bearing and screw-holding capacities are not critical, or where the latter defect can be overcome by new techniques. It might be expected to command a lower price than comparable wood particle board.

The fact that TPI particle board does not reach all the Indian standards for wood particle boards of medium density would not in itself prevent the board from being sold, if the price were sufficiently below that of standard particle board. If it became established a new standard could be set up for it.(28a)

Prices and Uses of Particle Board and Competing Products in India

The price structure of the wood panel industry in India has two main features which are relevant to this report. One is that for the reasons outlined in the first section of this chapter, sawn timber of comparable quality is still cheaper than particle board in India, while labour costs are so low that the additional cost of joining wood to form large surfaces was never mentioned by anyone who made the foregoing statement.

The price of a wood particle board comparable in structure and dimensions with TPI particle board was Rs.1.40 per square foot in November 1968. The price is quoted f.o.r. destination. The board may differ from TPI board only in so far as the specification does not state that it contains insecticide.(29) As the board is 3/4 in. (19 mm.) thick, the equivalent price per cubic foot is Rs.22.40. Teak, which has very good properties and is the most popular wood, in planks 8 feet long cost, in Delhi market, from Rs.26.50 to Rs.33.50 per cubic foot according to the other dimensions which ranged from 6 in. by 1 in. to 12 in. by 12 in.(30) Mango wood was stated to cost Rs.6 to 8 per cubic foot in Delhi.(31) In Bombay, teak was stated to cost Rs.35 per cubic foot, normal hard woods Rs.10 to 12 per cubic foot and "jungle wood", Rs.8 to 9 per cubic foot.(32) This comparative cheapness of wood other than teak is more likely to affect the demand for particle board in furniture, where wood is the traditional and preferred material, than in construction where materials other than wood are usual in several of the listed uses.

(27a) "Particle Board and Hard Board". By L.E. Akers, Pergamon Press, 1966, 47.

(28) Loc. cit.

(28a) Appendix I, item 6.

(29) Price list of Central India Board Products for Aucher Nova wood. Appendix II, item 47.

(30) Appendix I, item 95.

(31) Appendix I, item 92.

(32) Appendix I, item 48.

The other important characteristic of the price structure is that particle board when veneered with wood is suitable for various uses in which plywood and blockboard have already found markets, and being made of inferior wood is able to compete with them on price.(33) This feature would put the TPI particle board plant at a disadvantage in relation to most of the wood particle board plants, of which three out of the five still believed to be operating are associated with plywood factories(34), while a fourth, visited by the writer, had plant for making and applying veneer.(35)

Wood veneers in India fall into two classes, decorative and commercial. Teak falls into the first class and shisham into the second. Most plywood and blockboard have commercial veneer on both sides.(36) According to two sources, there is no difficulty in purchasing decorative veneer and three or four firms were said to supply it,(37) while commercial veneer is evidently scarce. Probably, price rationing restricts sales of decorative veneer. As mentioned previously, there seems to have been a tendency for the prices of less valuable woods to rise more steeply than that of teak.

The method of distributing wood may give an advantage in securing ply logs to established plywood firms, because apart from the timber auctions held at Government forests, it is possible for groups to obtain licences to purchase timber from a given area over a period of several years. An entrepreneur in the plywood industry said that it would be difficult to purchase commercial veneer from a plywood factory because of the shortage of supplies, remarking that one of the particle board firms, (which was not associated with the plywood industry) experienced difficulty in obtaining veneers. This firm is understood to have failed and ceased production. On the other hand, he thought it would be possible to sell particle board to the plywood industry;(38) a point of relevance to the TPI project.

The above, then, is the setting in which prices of particle board may be compared with those of other products in various uses.

Table 15 in columns a. and c. gives some results of a survey conducted by the FAO on the uses of panel products in India and other countries.

The percentages in the table are considered to be reasonably accurate since the plywood and particle board industries are represented by an efficient trade association,(39) and especially in the case of particle board since the number of producers is very low. The figures for estimated consumption *by volume* in columns c. and f. show that the consumption of particle board is above one tenth of that of plywood. It must however be remembered that much of the plywood against the heading "other" in row 13 is tea chest plywood which does not compete with particle board.

Subdivision of the total volume of particle board according to uses was not possible as there is no sub-division into"flat pressed" and "extruded" particle board (which is made by a different process).

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(33) "Marketing Particle Boards in Developing Countries with Special Reference to India". Loc. cit.

(34) Appendix I, Item 91.

(35) Appendix I, Item 28.

(36) Appendix I, Items 47 and 81.

(37) Appendix I, Item 94.

(38) Appendix I, Item 31.

(39) Appendix I, Item 4.

Furniture The bulk of furniture in India is still custom-made by very small undertakings. In the course of the survey, the writer gained the impression that the structure of the industry has changed little since a survey carried out in the Southern Region of India in 1957-8, and covering all the large scale units and 60 per cent of the small scale units, revealed that the sample consisted of 4 large scale firms employing 451 persons and 178 small firms employing 2,076 persons or on average 12 per firm.(40) It was generally stated to the writer that the small firms do not possess the tungsten tipped saws required for sawing particle board or the presses needed for applying veneer. The lack of facilities for using particle board was said to be reinforced by a strong preference on the part of the public for wood, especially teak furniture.(41)

Table 15 shows that both in the case of plywood and particle board a smaller proportion is used in the furniture industry than in construction. Although the proportion of total particle board used in furniture is higher than in the case of plywood, the absolute area may well be less because particle board tends to be thicker than plywood.

The writer was told that plywood is used only in better quality or decorative furniture, and particle board in medium grade furniture.(42) As the particle board used in furniture is mainly of medium thickness, 15 mm. to 19 mm. with occasional use of 12 mm. or even 9 mm. for interior fittings,(43) there is some scope for employing thinner plywoods which might be cheaper. When the thickness is the same, veneered particle board is cheaper than plywood. Thus, 12 mm. "Okal" particle board, with commercial veneer on both sides cost Rs.1.30 per sq. ft.; with commercial on one side and teak on the other, Rs.2.30; and with teak on both sides, Rs.2.80.(44) These prices which are f.o.r. destination, may be compared with Delhi wholesale prices for plywood of the same thickness, which were Rs.1.50 and Rs.1.55 for commercial veneer on both sides and Rs.2.75 for commercial on one side and teak on the other.

The strength of plywood is such that (apart from screw-holding at the edge) 1/8 in. (3.175 mm.) plywood can replace $\frac{1}{2}$ in. (12.700 mm.) particle board.(45) Wholesale prices quoted in Delhi market were Rs.0.50 for 3 mm. plywood with commercial veneer on both sides; Rs.0.58 for 4 mm. plywood, commercial veneer on both sides and Rs.0.45 for commercial veneer on one side and teak on the other. These prices are much lower than the prices for 12 mm. Okal board, quoted above.

Construction While particle board may compete with other panel products, such as fibre board and blockboard in the furniture industry, it is known to compete with blockboard, fibre board and insulation board, as well as bricks in the construction industry, and this competition will be discussed in connection with some of the uses for particle board listed in Table 15.

Other uses listed in column a. of Table 15, namely, flooring, floor and roof underlayment and concrete formwork, will be dealt with only briefly. Particle board is evidently not used in India either for floor or roof underlayment. In the first instance, concrete floors are normally tiled and the light type of roof made by laying particle board on rafters and

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(40) "Wood Based Industries - Furniture (Southern Region)". Small Scale Industry Analysis and Planning Report No. 45(S), Ministry of Commerce and Industry, Government of India, New Delhi, 1959, 1, 39.

(41) Appendix I, item 10.

(42) Appendix I, items 82 and 94.

(43) "Particle Board and Hardboard". By L.E. Akers, Loc. cit., 82.

(44) Price list for Okal Veneered Board effective from 1.4.1968. Okal board may be made by the extension process, which is cheaper than the normal particle board process.

(45) Appendix I, item 15.

covering it with tarred felt is evidently not strong enough to withstand the heavy rains of India. Much plywood is used in India for concrete formwork; untreated particle board is, however, not sufficiently water resistant for this use.

Flush doors are now very popular in India and are frequently made from blockboard 1 in. or $1\frac{1}{4}$ in. thick. Prices quoted in Delhi market for 1 in. blockboard with commercial veneer on both sides were Rs.2.65 per sq. ft. and with teak on both sides Rs.3.50. If to the price of Rs.1.75 per sq. ft. for plain 1 in. particle board is added a differential of Rs.0.30 for commercial veneer on both sides and Rs.1.80 for teak on both sides, the resulting approximate prices for veneered particle board are R.2.05 and R.3.55 per sq. ft.,[46] so that the particle board with commercial veneer which is the commonest type[47] could compete on price with blockboard, although the teak faced particle board could not. It has been stated that blockboard is slowly going out of use in India and is being replaced by plywood or plain or veneered particle board.[48] This evidence reinforces the implication of the above price comparison.

Since with doors, there appears to be little scope for substituting a thinner material, it is likely that particle board has an advantage also over plywood which the available data show to be dearer in the same thickness. It was stated that $\frac{3}{4}$ in. (19 mm.) blockboard and plywood with commercial veneer on both sides cost from Rs.2.10 to Rs.2.50 per sq. ft. while similar particle board cost from Rs.1.50 to Rs.1.75.[49]

According to Table 15, more particle board was used in ceilings than in flush doors. Mention was made in the course of the survey of using TPI particle board in ceilings for insulation purposes and for false ceilings to conceal trunking for air-conditioning, where its low thermal conductivity would be an advantage. According to the Indian Standard "Specification for Particle Board for Insulation Purposes",[50] the density of such particle board is not to exceed 400 kg. per cu. m. while its thickness can vary from 12 to 50 mm. There is also a specification for fibre insulation boards with a density of 400 kg. per cu. m. and a minimum thickness of 9 mm. increasing to 25 mm.[51] Insulation board suitable for lining corrugated iron buildings was said to cost Rs.0.50 per sq. ft.[52] A sample of low density board, 9 mm. thick, fibre board made entirely from bagasse fibre cost Rs.0.75 per sq. ft.

The machinery makers said that the thickness of TPI board may vary from $\frac{1}{2}$ in. (12.7 mm.) to 1 in. (25.4 mm.). At $\frac{3}{4}$ in. (19 mm.), the density may vary from 641 kg. per cu. m. ± 10 per cent. It seems unlikely that TPI particle board of standard density and thickness could compete with either of the special boards mentioned above, and there is so far no evidence that the density in any thickness can be reduced to the level of 400 kg./m.^{3} which would bring about a saving in raw materials comparable with that achieved by the normal insulation panel products specified above.

Over a quarter of the particle board produced in India in 1964-5 was used in walls and partitions.

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(46) Prices derived from lists supplied by Indian Plywood Manufacturing Company Limited.

(47) Appendix I, item 47.

(48) "Enquiry into Use Patterns Development Possibilities in the Application of Wood Based Panels". FAO Committee on Wood Based Panel Products, Rome, 1968, App. 276.

(49) Appendix I, item 47.

(50) IS : 3129-1965, Indian Standards Institution, New Delhi, 1965,4, 5.

(51) Indian Standard Specification for Fibre Insulation Boards, IS : 3348-1965. Indian Standards Institution, New Delhi, 1965, 4, 6.

(52) Appendix I, item 98.

While approaching New Delhi airport from the air, the writer noticed that the internal partitions in many unfinished dwellings were of brick. The competitive effectiveness of brick for this purpose was confirmed in interviews, and the following prices were quoted: From Rs.0.75 to Rs.1.50 per sq. ft. for core and finish according to quality.(53) A price of Rs.1 per square foot for brick partitions was quoted by two sources in Bombay.(54) The Builders Association of India who quoted the price Rs.1 per sq. ft. for brick partitions, said that TPI particle board would have to compete with wood fibre board 12 mm. thick at Rs.0.60 per sq. ft. in such uses as ceilings and partitions.(55) In the writer's opinion, two sheets of fibre board nailed to battens, would be necessary for a partition, so that the cost without labour and battens would be Rs.1.20 per sq. ft.

Particle board might have an advantage over brick for partitions on the upper floors of tall buildings owing to its lighter weight. It would still have to compete in this use with fibre board and insulation board.

A use suggested to the writer for TPI particle board was in temporary partitions or single-panel screens, used in India to divide large rooms into smaller areas. A promising outlet for these partitions was foreseen in rural dwellings for the accommodation of visiting relatives.(56) Elsewhere it was stated that at current income levels, home-made straw matting of negligible cost is, at present, more likely to be used for this purpose by peasants.

Plastic veneered particle board has so far been omitted from the discussion because it can be used in the furniture, construction or transport industries and nothing is known about its distribution between these uses. Particle board with plastic laminate, is very popular in India, although it is expensive in comparison with other veneers. It was stated by a prominent member of the particle board industry that Indian plastic manufacturers insist on selling decorative plastic laminate 1/16 in. thick at Rs.5 per sq. ft. Since much of the thickness is provided by layers of papers, this practice is profitable. Another firm said that "commercial" plastic laminate cost Rs.1 per sq. ft., while decorative plastic laminate cost Rs.3.50 wholesale and Rs.4.50 retail.(56a) The foregoing prices refer to a thickness of 1/32 in. The proprietor of a small furniture firm stated that he paid Rs.5.75 per sq. ft. for coloured plastic laminate which appeared to be 1/32 in. thick.(56b) This man applied the laminate in his shop by means of clamps and adhesive. It is also applied by particle board manufacturers, using presses.

It is thus obvious that if a cheap and simple method of coating the board with a plastic surface in one process could be developed by TPI, groundnut particle board might be provided with an advantage over boards covered with a purchased plastic laminate.

Conclusion The foregoing review of uses and prices of particle board and various competing products at the present time supplements the evidence of excess capacity by showing that in most uses wood particle board has difficulty in competing with ordinary wood and bricks or plywood, fibre board and insulation board. When veneered with wood it can compete with plywood and blockboard in flush doors and with plywood in uses where the

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(53) Appendix I, No. 2.

(54) Appendix I, items 42 and 43.

(55) Appendix I, item 43.

(56) Appendix I, item 12.

(56a) Appendix I, item 47.

(56b) Appendix I, item 89.

plywood has to be equally thick. Medium density wood particle board is unlikely to compete with plain insulation board and plain fibre board except when being veneered gives it a quality advantage. Even though expensive, wood particle board coated with plastic laminate has a special quality advantage owing to the popularity of the latter finish.

In general, it can be said that groundnut particle board might be able to compete in uses both in the furniture industry and in construction and also possibly in vehicles, if its price could be low enough to compensate for those attributes in which its quality is lower than that of wood particle board.

Several persons interviewed in India who saw samples of unsanded groundnut particle board said that it would sell freely at present if the price were from Rs.0.75 to Rs.0.80 per sq. ft.(56c)

One group thought that the unsanded groundnut particle board was comparable in quality with mango wood, a cheap general purpose wood, the price of which as stated above was Rs.6 to 8 per cu. ft. in Delhi.(56d)

Row 37 of Table 4 shows that, at the lowest cost site (in Andhra Pradesh), assuming three shift operation, the use of purchased resin and rail delivery the cost per sq. ft. would be Rs.1.19 which is well above the price at which the demand for the board would be fairly elastic.

The question whether the propsects of groundnut particle board are likely to improve in the near future will be discussed in the next section of this chapter. Chapter 15 on the profitability of the project will deal with the returns which may accrue allowing for certain possible modifications in the costs.

Possible Future Trends in the Indian Market for Particle Board

With regard to future possibilities, the first question is whether the future demand and supply conditions for wood and wood products is likely to improve the competitive position of particle board in general and if the answer is in the affirmative, the second question relates to the prospects of particle board made from groundnut husks.

Unfortunately, lack of data precludes any attempts at detailed projections; however, the available data make it possible to state some opinions.

Table 16 shows the estimated *per caput* and total consumption of sawn wood and plywood in India compared with changes in per caput national income over the ten year period 1955 to 1965 in columns a. b. d. and e. Columns f. and g. give estimates of *per caput* net national income at 1960-61 prices from two independent sources which fortunately overlap.

According to this table during the period 1955 to 1960, when per caput incomes were rising there was a significant increase in the consumption of plywood, both *per caput* and in total. The bulk of the increase was in the consumption of commercial plywood, output of which in terms of square metres rose by 121 per cent between 1955 and 1960, while teachest plywood rose by only 8 per cent.(57) This indicates that increased consumption may have

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(56c) Appendix I, items 39, 43 and 47.

(56d) Appendix I, item 64.

(57) Statistics provided by the Federation of the Plywood Industry.

taken place in the construction, transport and furniture industries. Table III on page 19 shows that investment in construction was falling off relatively to total investment during the second plan period (1956 to 1961). The presumption that at least some of the increased demand associated with rising per caput incomes came from the furniture industry is supported by independent evidence. The results of a survey carried out in urban areas of South India (Andhra Pradesh, Kerala, Madras and Pondicherry) showed that over the years 1950-51 and 1957-58 consumption of furniture was increasing at an average rate of 15 per cent per annum, while production was increasing at 16 per cent. Using data published in this report, it was estimated that urban per caput consumption of furniture was at the level of only Rs.0.73 per head in 1957-58. The same statistic for the rural population was stated to be Rs.0.37 in 1951.(58)

Income per head in Andhra Pradesh and Madras (comprising about 80 per cent of the population of South India) was rising at a compound rate of about 1.7 per cent between 1955-56 and 1960-61. Over the period from 1960 to 1965, income per head fluctuated showing no consistent upward trend, while there was no increase in per caput consumption of sawn wood or plywood. Figures for the production of tea chest and commercial plywood in square metres from 1961 to 1967 are given in Table 12.

The above data indicates that even in urban areas, furniture consumption is at a very low level in India and that when incomes are rising, consumption rises at a higher rate. It is of some interest that an independent calculation (on a cross section basis) of the income elasticity of demand for furniture yielded the relatively high value of 1.61.(58a)

It is possible that increased demand for furniture which may result from higher incomes in future may bring about a change in the structure of the Indian furniture industry so that the large numbers of very small firms using labour intensive methods to produce rather expensive furniture(58b) would be superseded by larger firms using mass produced methods and advanced techniques. Such a development might lead to increased use of particle board. At present very few furniture firms are equipped to apply veneers, which limits sales of plain particle board. As far as wood veneers are concerned, this limitation is likely to continue, as ply-logs will continue to be scarce (see below). However, the shortage of synthetic finishes is perhaps less likely to persist.

The trend of total demand for wood and panel products in future will depend on the level of investment in construction and transportation and on the level of per caput disposable personal incomes.

No information was collected on the use of panel products in transportation. However, Table 15 shows that over 80 per cent of flat pressed particle board was used in furniture and construction, so that the omission of transportation from the discussion does not involve a serious gap.

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(58) "Wood Based Industries - Furniture (Southern Region)". Small Scale Industry Analysis and Planning Report No. 45(8). Loc. cit.

(58a) "International Market Analysis". By R. Moyer. Journal of Marketing Research. 1968, V, No. 4. November. 356.

(58b) Appendix I, item 49. A three piece suite covered with a material like rexine in the showroom of this small firm cost Rs.1,500 or (£83) and a brocade covered fireside chair with a 4 in. foam seat cushion cost Rs.325 or £18.

While much of the discussion and projections contained in the fourth five year plan are now out of date,[59] some new estimates of building material requirements were in preparation early in 1969 for a New Fourth Five Year Plan (1969-70 to 1973-74).[60] It is stated in this draft report that the Planning Commission expects about 5 per cent rate of growth in the agricultural sector resulting in an overall growth rate of 5 to 6 per cent and that it is felt that an investment ranging between Rs.180,000 million and Rs.210,000 million would be required to achieve a growth rate of 5 to 6 per cent. The National Building Organisation (NBO) comments that the earlier Fourth Plan had estimated an investment of Rs.221,600 millions.

Using a range of assumptions about the proportion of total investment applied to construction the NBO arrived at the estimates of shortages shown below.

Table V

Expected Shortage of Building Materials During the Fourth Plan

	Material	Unit	Shortage in building materials when investment in construction is: Rs. million			
			110,000	120,000	132,000	143,000
	a	b	c	d	e	f
1	Bricks	1,000 million	51	65	82	99
2	Cement	Million metric tons	no shortage	3	8	15
3	Steel	Million metric tons	-do-	no shortage	0.4	2.9
4	Timber	Million cubic metres	-do-	0.1	1.4	2.8

Source See footnote 60 below.

It was estimated that production of bricks during the five year period of the fourth plan would total 100,000 million so that the expected deficits in row 1 of Table IV are large in relation to the total current supply. Whether this augurs well for the use of particle board in partitions, depends on the elasticity of supply of bricks in India, which may be much greater than that of wood.

The deficit in timber is based on an assumed annual output of about 6 million cu. m. of timber, which as stated above, is assumed by the FAO to be round wood.[61] The NBO assumes that roughly 45 per cent of timber goes into the construction industry, so that over five years 13.5 million cu. m. would be available for this purpose. The estimated short falls

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(59) "Fourth Five Year Plan: A Draft Outline". Loc. cit.

(60) "Assessment of Building Materials Requirements for the New Fourth Five Year Plan". (First Draft). National Building Organisation, New Delhi, 1969.

(61) This point can be established by comparing the figure for Indian production of round wood in 1964-5 on p.12 of "1968 Yearbook of Forest Products". Loc. cit., with figure for Indian output of timber for 1964-5 on p.69 of "Statistical Abstract of the Indian Union, 1967", Government of India, 1968.

indicated in row 4 of Table V are much lower in relation to the total assumed supply of timber than was the case with bricks. However, the supply of timber is inelastic. According to the 'Fourth Five Year Plan':(62) "This plantation programme will not appreciably affect the supply of industrial wood before 1980-85, since the plantation of even quick growing species takes about 15 years to mature and the plantation of economic species would take between 30 and 60 years". Some alleviation of the shortage was expected from forest clearance for improved plantations and from the use of secondary timbers.

Since round wood includes ply-logs, the expected deficit indicates an increased demand for particle board and fibre board. Whether a shortage actually occurs, will depend on whether a high level of constructional activity is attained. This, in itself, would create an additional demand for furniture which may be reinforced by increased demand from consumers with higher incomes.

There are indications that the Indian economy is recovering from the period of industrial slack and inflation resulting from two years of drought and food scarcity. In the year to the end of March 1968, national income rose by 8.9 per cent at constant prices and is estimated to have increased by 3 per cent in the year to the end of March 1969, the key factor having been the recovery in the agricultural sector, accounting for over 45 per cent of India's domestic product. "Unofficially, and on a very provisional basis only, it has been estimated that the longer term outlook for about the next eight years, might be an average compound growth rate of 4 to 5 per cent a year in real national income".(63) Since population is expected to increase at a compound rate of 2.5 per cent per annum,(64) per caput real income would also rise.

Assuming that the expected pressure on an inelastic supply of industrial timber results during the next decade from greater activity in the construction industry and higher per caput incomes, it remains to consider the possible effect on the particle board and fibre board industries.

The current excess capacity in the wood particle board industry is about 37,000 metric tons. Assuming the average density to be 40 lb./cu. ft. or 640.72kg./cu. m., this amounts to 57,748 cu. m., which is small compared with the expected timber deficiencies when investment in construction is at or above Rs.120,000 million; (See Table IV on p. 30) which range from 100,000 cu. m., to 2,800,000 cu. m. The raw material for wood particle board in India consists of firewood (trimmings) and saw mill waste. Upward pressure on the price of these is likely to come from increased substitution of wood for dung as fuel as incomes rise and also from increased demand for wood raw material and for particle board and might easily outweigh the small reduction in capital costs resulting from the use of excess capacity.

The increased production of fuel wood by State Forest Departments envisaged under the fourth plan(65) will presumably be used as fuel, while little expansion of the output of saw mill waste can be expected. Groundnut production is planned to increase from an average level of 6 million metric tons per annum under the third plan (1961-62 to 1965-66) to

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(62) Loc. cit., 205.

(63) National and Grindlays Review, 1969, *15*, No. 2, 13.

(64) "Fourth Five Year Plan". Loc. cit. 346.

(65) "Fourth Five Year Plan". Loc. cit. 205, 206.

8.5 million metric tons per annum by the end of the fourth plan in 1973-74.(66) If this target should be reached, husks would become more plentiful. However, there is likely to be some upward pressure on their prices, because husks are used as an industrial fuel. It is of some interest that the annual growth rate of groundnut output implied by the above production figures is about 7 per cent., which is the same as the annual rate of growth of industrial output considered possible during the next eight years in a recent unofficial estimate.(67) There is thus a chance that husk prices might rise less than the price of wood material for particle board.

There might in future be more competition than at present from jute sticks and bagasse which can be used to make particle board of good quality,(68) while fibre board is at present being made from bagasse in India. Both bagasse and jute sticks are used as industrial fuel. Jute sticks are already being used for paper pulp and there are plans to base increased output of paper and newsprint on bagasse,(69) the production of bagasse being in excess of the amount required as fuel for sugar refineries. Groundnut husks are not a suitable raw material for paper pulp and the suitability for this purpose of bagasse and jute sticks may prevent them from competing with groundnut husks as a raw material for particle board.

There is thus some reason to expect that the competitive position of particle board and fibre board vis-a-vis wood in India may improve during the next two decades. The position of groundnut particle board may also improve as saw mill waste and firewood become scarce in relation to demand.

The position of particle board in general would improve if the price of resin were to fall with increased production as it has done in advanced countries. If the Indian Government were to reduce or abolish the excise duty on UF resin as a concession to the shortage of wood this would cause the market for particle board to expand still further. The revenue from this source can be only a very small fraction of total revenue.

International Trade in Particle Board

The possibility of exporting particle board from India has not been discussed in this report because the Indian price level was expected to be well above the world price level for particle board owing to the very high price of resin. In any case, owing to its high ratio of volume to value, little particle board is traded internationally.

In 1967 only 11 per cent of estimated world production of particle board was traded, and 90 per cent of this trade came from European countries.(70)

The following statement is, therefore, surprising: "The first ever consignment of 500 tons of Indian particle board was exported from India towards end of April 1969. A leading Indian firm had secured an order for export of 5,000 tons of particle board valued at Rs.6,75 million from

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(66) Appendix I, item 16.

(67) National and Grindlays Review, 1969, Loc. cit., 13.

(68) "Particle Board Manufacture and Application". By L. Mitlin, *Loc. cit.*, 59.

(69) "Fourth Five Year Plan". Loc. cit., 275.

(70) 1968 Yearbook of Forest Products. Loc. cit., xiii, xiv

a US Firm in N. Carolina. Repeat orders are assured after completion of current contract".(71) Assuming that this was a medium density (40 lb./cu. ft.) particle board $\frac{3}{4}$ in. (19 mm.) thick, the price per square foot may be roughly estimated at Rs.1.53, This may be compared with January-May 1969 ex-wharf UK prices of chipboard (wood particle board) made in Finland with a density of 40.5 lb. per cu. ft. which were as follows:

prices per sq. ft.(72)

	shillings	Rupees
18 mm.	1.2725	1.15
22 mm.	1.5275	1.37

According to the USA trade returns, 1,224 metric tons of particle board were imported from India into USA in 1969. It should not, however, be concluded that groundnut husk particle board could also be exported from India without further investigation especially with regard to its acceptability on the Indian home market.

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(71) Monthly Development Digest, May 1969, Economic and Development Research Ltd., Chelmsford. Reprinted from Monthly Newsletter, Indian Investment Centre, May 15th, 1969.

(72) Prices supplied by James Latham Ltd., London.

CHAPTER 5

THE PROFITABILITY OF THE PLANT

It has been shown in Chapter 4 that at present the market for wood particle board is very limited especially if the board is not veneered, one of the main reasons for this situation being that particle board costs more than comparable industrial wood. It was hoped that owing to the low cost of groundnut husks and the omission of the initial processes in making wood particle board, the groundnut husk particle board might be able to compete.

In this chapter the question whether the process would be profitable in current circumstances is examined in several ways. The initial approach is to calculate the rate of return according to an Indian standard using rather favourable assumptions with regard to cost and price. The discounted cash flow method is then used, with modified costs to estimate a selling price, yielding an internal rate of return which would satisfy the aid criteria of the Ministry of Overseas Development. The costs are then modified again in an unfavourable direction, to illustrate the dependence of the results of the previous calculation on favourable cost assumptions. At this stage a comparison is made with the estimated cost of wood particle board.

Rate of Return Approach

One of the difficulties of assessing the profitability of the process is that of estimating a price for a new product within the scope of the present study, it is only possible to deal with the subject approximately. We know that at current price levels, where a wood particle board costs Rs.1.40 per sq. ft., the elasticity of demand is low while it is likely to be much greater at the level of Rs.0.75 to Rs.0.80 per sq. ft. where it could compete with the cheaper types of wood.

Several of the firms stated the rate of return on capital which they would expect. The lowest return expected, which was also defined in a manner normally accepted in this country, namely as expected profit after allowing for depreciation but before tax, as a percentage of investment involved, was 15 per cent; after the third or fourth year.

The price per unit which would yield this rate immediately was estimated for Site 1 at Kurnool, (See Table 4, column c.) The total invested capital derived from rows 11 and 13 of Table 3 for this firm would be Rs.3,426,010. A 15 per cent return on this requires a profit per sq. ft. of Rs.0.15 Row 37c of Table 4 shows that the cost per sq. ft. including depreciation is Rs.1.19, so that the selling price would have to be Rs.1.34 per sq. ft. to yield the required rate of return. However in order to minimise unit costs, it has been assumed that the plant is operating on three shifts with an output of nearly 4,000 tons per year or nearly half the current output of the wood particle board industry. It is very unlikely that this quantity of groundnut particle board could be sold at a price so close to that of wood particle board which has certain superior properties.

It has been shown above (see page 14) that it would be possible to reduce costs if resin could be made in a captive plant at Rs.4,254 per ton, and if the product were delivered by truck instead of by rail, so that the

estimate of working capital could be reduced from four to two months operating costs. (see page 15). The result of these modifications is shown in column d. of Table 4 and yields a unit cost of only Rs.1.02 per sq. ft.

The total investment required in this case (derived from rows 11 and 14 of Table 3) and row 2 of Table 22 would be Rs.2.877,033. A 15 per cent return on this requires a profit per square foot of Rs.0.12. If this sum is added to the average cost of Rs.1.02 per sq. ft. the price becomes Rs.1.14 per sq. ft. At this level the prospect begins to appear more hopeful, although the price is still above that of comparable wood.

Even at such a low price, the assumption that an additional turnover of nearly 4,000 tons (or half the current output of wood particle board) can be sold is likely to be unrealistic because of competition from wood and the aversion to unveneered particle board. The two firms visited last, who were informed about the high cost of producing groundnut particle board said they thought it would be better to run the plant on one shift for a while. Costs for Site 1 operating on one shift have therefore been calculated for single shift operation for the purpose of discounted cash flow analysis, and also to investigate economies of scale. Cost for single shift operation have been estimated in columns c. and d. of Table 7. Those in column c. are comparable with the costs in column c. of Table 4. It can be seen from comparison of row 37c. in the two tables that unit cost rises from Rs.1.19 to Rs.1.31 per sq. ft. an increase of 11 per cent, which is rather low owing to the high contribution of raw material to total costs.

A further modification suggested by the firm at Site 1 has been incorporated in column d. Hitherto it has been assumed that plant and spare parts are imported duty free. Now it is assumed that an import duty of 27½ per cent is charged on both these items. As before, costs are assumed to be reduced by truck delivery and resin made in a captive plant. The resulting cost per sq. ft. is Rs.1.17 (see row 37d. of Table 7). Costs based on these modifications are used for discounted cash flow analysis.

Discounted Cash Flow Approach

If this approach is used it is possible to take account of the Indian system of company taxation and incentives for new enterprises.(1)

Table 20 shows how the appropriate depreciation and "tax holiday" allowances are calculated for the DCF calculations, shown in Table 17 and based on the same assumptions as column d. of Table 7.

Depreciation is allowed on the diminishing balance, the apparently appropriate rates being 10 per cent for the building and 10 per cent for the plant,(2) when operating single shift. The amounts on which tax is allowed are shown in columns a. to f. and c. of Table 20.

The tax holiday means that new industrial undertakings are exempt from income-tax on this income up to 6 per cent of capital employed in the undertaking for the first five accounting years in which production takes place.(3)

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(1) "Taxes and Incentives: A guide for Investors". Op. cit.
(2) Loc. cit 84, 91.
(3) Loc. cit 31, 32

The rules for estimating capital employed have been interpreted to mean the sum of the net value of fixed assets (cost less depreciation) plus working capital plus half the total profits of the accounting year.(4) The amounts exempt from tax are calculated in columns g. to j. and shown in column k. of Table 20.

The method and layout for calculating DCF's are those illustrated by Alfred and Evans.(5)

The first DCF calculation is shown in Table 17 which is self-explanatory, if sources and footnotes are read. It explores the profitability of operating on one shift at Site 1 in Andhra Pradesh, assuming that the resin is made in a captive plant and the product delivered by truck. Import duty at 27½ per cent on plant and spares as well as the cost of the resin plant is included in the capital costs. The cash outflows are derived from rows 12 and 16 of Table 3 and the profit in column f. from rows 39 and 41 of Table 7. The assumed selling price was Rs.1.40 per sq. ft. which is equivalent to the price of comparable wood particle board, and the operating efficiency was 86 per cent.

The object of Table 17 was to ascertain whether under the stated assumptions the internal rate of return would reach the level of 8 per cent required by ODM before a project can be considered suitable for aid.(6) The table shows that the ratio between the cash outflows and inflows is approximately 1 when a discount rate of 6½ per cent is used. This is above the 5 per cent level at which ODM considers a project worth further investigation.

One of the assumptions upon which the two preceding calculations were based is that the operating efficiency was at the level of 86 per cent which was postulated by the machinery makers. In view of the low levels of operating efficiency prevalent in developing countries, it was thought useful to test the effect on the internal rate of return assuming a lower operating efficiency of 70 per cent.

Apart from lack of demand for the product the factor considered by the writer most likely to cause low operating efficiency in India is the inadequate supply of electricity. This factor is less likely to affect Site 1 than other sites, since the firm in Andhra Pradesh has a generator (see page 10).

Operating costs on this assumption for Site 1, working on one shift are shown in Table 8, and the accompanying DCF calculation in Table 19. Assuming that the output of 1,066 metric tons can be sold at a price of Rs.1.40 per sq. ft. the internal rate of return falls to 3½ per cent which is unduly low.

Since the plant was originally intended to operate on double shift and it was felt that at some later stage the market might improve sufficiently to absorb this enlarged output, another costing was worked out for Site 1 assuming double shift working and an output of 2,132 metric tons, this assumption being the same as those underlying column d. of Table 7. This costing is not included in the report. However the tax allowances are shown in Table 21. A DCF calculation based on the double shift costing is shown in Table 19. Here, the internal rate of return is over 14 per cent, which is a considerable improvement and is in excess of the 8 per cent level at which a project is considered likely to be viable.

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(4) Loc. cit. 32, 33

(5) "Appraisal of Investment Projects by Discounted Cash Flow: Principles and some Short Cut Techniques". By A.M. Alfred and J.B. Evans, 2nd Ed. Chapman and Hall, London, 1968.

(6) Lecture given at Aid Administration Course for officers from the Ministry of Overseas Development, University of Sussex, 30th September to 11th October, 1968.

The price of the particle board has throughout been assumed to be Rs 1.40 per sq. ft. or the same as that of wood particle board.

Since the properties of TPI particle board are somewhat inferior to those of wood particle board, the former would in fact have to be sold at a lower price. The foregoing calculation shows that it would be possible to charge a lower price, when producing on double shift and still earn an internal rate of return above 8 per cent. It is believed that this rate could be achieved at a price of about Rs.1.30 per sq. ft. It was not thought necessary to make the calculations required to find the exact price.

Finally, in order to throw some light on the conditions of competition with the existing wood particle board industry, the cost of producing wood particle board at Site 1 was estimated in Table 9 with, *mutatis mutandis*, the same assumptions as those underlying column d. of Table 8. The main assumptions which are unchanged are single shift working at 70 per cent operating efficiency, resin made in plant and delivery of output by truck. The main changes in the calculation are due to three additional items of equipment, the chipper, fine chipper and dryer costing Rs.495,000 c.i.f. plus Rs.136,125 import duty. The extra processes require 5 extra operatives. Additional electricity and steam are required. Other costs depending on capital costs such as insurance of plant and depreciation are also affected.

According to the available data, the price of suitable wood varies from Rs.30 to Rs.80 per metric ton, depending on the location, so that the assumed price of Rs.35 per ton (1d. of Table 8) is very conservative.

The assumption of 70 per cent operating efficiency was chosen for the comparison because together with single shift operation, it would bring the calculation closer to the current conditions of the industry which is working at about one sixth of total capacity. Row 38 of Table 9 shows that the cost per sq. ft. for wood particle board including depreciation is Rs.1.53 compared with Rs.1.25 for groundnut particle board (row 37d. of Table 8). The estimated price of wood particle board f.o.r. destination is above the quoted price of Rs.1.40. This suggests that at present, producers of wood particle board, whose costs may be even higher than those shown in Table 9 are unlikely to be covering their overheads in the price charged.

APPENDIX I

List of Institutions and Firms Visited in India, December 1968 to February 1969

Delhi 1968

9th December	1	British High Commission, Economic and Commercial Division, Chanakyapuri, New Delhi 21. F. Maynard, Commercial Counsellor B. Valentine S. Simms
	2	National Building Construction Corporation, 44 Ring, Laj Pat Nagar 3, New Delhi 24. Mr. Murti, Chief Engineer
10th December	3	National Council of Applied Economic Research, Parasila Bhavan, 11 Indraprastka Estate, New Delhi 1. Dr. S. Balakrishna, Technical Director
	4	The Federation of the Plywood Industry 4E/13 Jhandewalan Extension, New Delhi 1. Mr. G. B. Deshpande, Secretary
11th December	5	Indian Investment Centre 3 Parliament Street, New Delhi. Mr. N. R. Srinivasan, Technical Adviser (Chemical Industries)
	6	Indian Standards Institution, Manak Bhawan, Bahadur Shah Zafar Marg, New Delhi. Mr. R. Nagarajan, Director of Civil Engineering Branch Mr. J. Venkataraman
	7	Directorate General of Technical Development Ministry of Industrial Development, Udyog Bhavan, New Delhi. Mr. J. Singh Matharu, Development Officer (Timber)
12th December	8	National Council of Applied Economic Research Parasila Bhavan, 11 Indraprastka Estate, New Delhi 1. Dr. S. Balakrishna
	9	Ministry of Food, Agriculture, Community Development and Co-operation, Krishni Bhavan, New Delhi. Mr. Harisingh, Inspector General of Forests

Delhi

12th December	10	Oriental Building and Furnishing Co. (P) Ltd. 'M' Block, Connaught Circus, New Delhi. Mr. Darshanjit Singh
	11	Joseph Allen Associates Sundar Nagar 11, New Delhi. Mr. Bhalla
13th December	12	British High Commission Economic and Commercial Division, Chanakyapuri, New Delhi 21. Mr. B. P. Jain Birla Bros. PVT. Limited
	13	State Trading Corporation Express Building, Bahadur Shah Zafur Road, New Delhi. Mr. H. L. Tandon
	14	National Building Organisation Nirman Bhavan, Maulana Azad Road, New Delhi. Dr. A. V. Rao, Materials
	15	Anil Hardboards Ltd., 60 Janpath, New Delhi 1. Mr. S. Singh, Regional Manager
15th December		Travelled to Hyderabad

Andhra Pradesh

16th December	16	Regional Office, Oilseeds Development Ministry of Food, Agriculture, Community Development and Co-operation, Telhan Bhavan, Hyderababad-29. Mr. N. S. Maini, Director (acted as Liaison Officer) Dr. G. V. Ramanamurthy, Deputy Director Mr. M. D. Zainulabedeen, Cotton Extension Officer
	17	Discussion with Federation of Andhra Pradesh Oil Millers' Association, Hyderabad.
	18	Tungabhadra Industries Limited (in Hyderabad)
	19	Aryan Industries Oil Mill, Hyderabad.
	20	Regional Research Laboratory Council of Scientific and Industrial Research, Hyderabad 9. Dr. Sidhu, Director Dr. Achaya Dr. Krishnamurty Dr. G. V. Ramanamurthy

Travelled to Kurnool

18th December

21 Tungabhadra Industries Limited, Kurnool.

Mr. Sadagopal, Vice-president and Manager
Mr. Jagan Nath Rao
Mr. Vasanta Gupta, Chief engineer

Travelled to Adoni

22 Adoni Cottonseed Industries, Adoni.

Mr. T.G. Vasant Gupta, Chief executive

Travelled to Kurnool

Andhra Pradesh

19th December

23 Tungabhadra Industries Limited, Kurnool.

Travelled via Hyderabad to Bangalore

Mysore

20th December

24 Indian Plywood Industries Research Association, Tumkur Road, Post Bag No. 3, Bangalore.

Dr. D. Narayanamurti, Director

25 Mysore Industries Commission
Bangalore 1.

Mr. T. Shamanna, Commissioner of Industries
Dr. D. Narayanamurti

26 Ravi Vegetable Oil Industries (in Bangalore)

Mr. Y. Kantharaj

21st December

Travelled to Mysore and back to Bangalore

27 Central Food Technological Research Institute Mysore 2A.

Dr. H.A.B. Parpia, Director
Mr. G.S. Bains, Food technologist

28 Mysore Chipboards Limited
2909 Temple Road, Vari Vilas Mohalla, Mysore-2.

Members of firm
Mr. G.S. Bains

22nd December

Travelled to Davengere and back to Bangalore

29 Ravi Vegetable Oil Industries, Davengere.

Mr. R.R. Sreenivasa Murthy, Proprietor
Mr. R.S. Vaidyanathan, Works manager
Mr. C.V. Suryanarayana Rao, Office Manager
Mr. P.S. Srinivasarao, Chief Accountant
Mr. S.V. Sreenivasaiah, Secretary

23rd December

30 Kurlon Factory, Yeshwantpur, Bangalore 22.

Mr. P.V. Acharya, Proprietor

23rd December	31	Mysore Commercial Union Limited, Yesvanthpur, Bangalore. Mr. K.P. Parakh Dr. D. Narayanamurti
	32	Indian Plywood Industries Research Asscciation (see item 23 above) Dr. D. Narayanamurti, Director Dr. B.K.R. Prasad, Electrical Engineer
24th December	33	Southern Regional Electricity Board 386 Sadashiva Nagar, Bangalore 6. Mr. B.M. Safiulla Dr. B.K.R. Prasad
	34	Mysore State Electricity Board, Bangalore. Mr. K.S. Subrhamanyan, Chief engineer Dr. B.K.R. Prasad
		Left Bangalore on leave
30th December		Arrived in Bombay
Maharashtra		
31st December	35	Office of the British Deputy High Commissioner in Western India (BDHC) Mahatma Gandhi Road, Bombay 1. Mr. W.E. Henry, Second Secretary Commercial
	36	Maharashtra Industrial Development Corporation (MIDC) Maharashtra Investment Centre, Orient House, Mangalore Street, Bombay. Mr. B.N. Bhaguat, Chief Executive Officer, MIDC Dr. S. Godber, Joint Director, Industries Department, Government of Maharashtra Mr. Korgaonkar, Deputy Director of Industries Other officers of MIDC
	37	Hindustan Sugar Mills Limited 2nd Floor, 51 Mahatma Gandhi Road, Bombay 1. Mr. Nivatia
	38	at BDHC Mr. P.J. Udani, Hon. Secretary, Andhra Pradesh Branch of Builders Association of India.
1st January (Holiday)	39	Anil Hardboards Limited, Laxmi Insurance Building, Sir P.M. Road, Fort, Bombay. Mr. G.R. Jolly, Managing Director
2nd January	40	at BDHC Mr. J.S. Badami, General Manager Swastik Oil Mills.

	41	Mr. Ram Sharma, Director Omrao Industrial Corporatio PVT. Limited.
Maharashtra		
2nd January	42	Maharashtra State Co-operative Bank (MSCB) Sir Vithaldas Thackersey Memorial Building, 9 Bakehouse Lane, Fort, Bombay. Mr. V.M. Joglekar, General Manager Dr. W.C. Shrishimal, Manager Dr. J.G. Kane, Professor of Oil Technology Bombay University Dr. S.D. Mehta, Technologist, (Acted as Liaison Officer) Other officers of MSCB
	43	Builders Association of India (BAI) United India Building, 2nd Floor, West Wing, Sir P.M. Road, Fort, Bombay. Mr. H.J. Shah, Ex-president of BAI Mr. R.L. Gandhi, Vice-president of BAI Mr. R.N. Bannerjee, Hon. Secretary of BAI Other member of BAI
3rd January	44	CIBA of India Limited, Plastics Division, Esplanade House, 29 Waudby Road, Fort, Bombay. Mr. O. Geng, Director Mr. N. Jagadan, Deputy Manager
	45	Wood Polymer Limited 59 Apolo Street, Bombay. Mr. Yashwant Shah
	46	at BDHC Mr. S.L. Bheda Premji Banji and Company Veraval, Gujarat.
	47	Central India Board Products Limited, Wallace Flour Mills, 9 Wallace Street, Fort, Bombay. Mr. H.K. Vissanji
4th January	48	Sunderdas Saw Mills, Opposite Reay Road Station, Bombay 10. Mr. D.P. Ashar
	49	West India Vegetable Products Limited Hasham Premji House, 5 Ghoga Street, Bombay.
Gujarat		
5th January		Travelled to Ahmedabad

Gujarat

6th January	50	Industries, Mines and Power Department Sachivalaya, Ahmedabad 15. Mr. S.M. Ghosh, Secretary of Department Mr. M. Shinegnan, Industries Commission Mr. M.G. Shah, Gujarat Industrial Investment Corporation Mr. D.S. Parikh, Assistant Director of Industries (acted as Liaison officer) Other Senior Officials
	51	K.P. Shah and Company, Jamnagar Mr. K.P. Shah
	52	Gujarat Chamber of Commerce and Industry, Ashram Road, Ahmedabad 9.
	53	Sachivalaya, Ahmedebad 15. Mr. Joshi, Chief conservator of forests Mr. Karamchandam, Forest utilisation officer
7th January	54	Visits to Factories Naroda Industrial Area, Ahmedabad.
	55	Office of the Industries Commissioner Multi-storeyed Building, Lal Darwaja, Ahmedabad 1. Mr. G.G. Dave, Technical adviser (chemistry) Mr. N.M. Soparkar, Joint director of industries.
8th January		Travelled to Rajkot
	56	Rajkot Chamber of Commerce Mr. C.G. Kothari Saurashtra Solvent Extraction Company (P) Limited Dhibarbai Road, Rajkot, Saurashtra.
	57	Makudra Oil Cake Industry (P) Limited Bhaktinagar Railway Station, Rajkot 2.
9th January		Travelled to Jamnagar
	58	Saurashtra Oil Mills Association (SOMA) Jamnagar.
	59	Collector of Saurashtra District, Jamnagar.
	60	Site for SOMA Laboratory, Jamnagar.
	61	Oceanic Solvent Industries, Jamnagar. Mr. V.D. Patel
10th January	62	Reliance Trading Company, Station Road, Jamnagar. Mr. R.M. Shah

Gujarat

10th January	63	Visits to miscellaneous factories
		Travelled to Junagadh
11th January	64	Chamber of Commerce, Junagadh Mr. M.R. Shah, President
	65	Dipak Industries Mr. V.J. Patel
		Travelled to Veraval
12th January	66	Madhau Khanserai. Mr. R.D. Shah)Partners Mr. Ramhal)
	67	Prabhat Solvent Extraction Industries (P) Ltd. Manavadar. Mr. D.D. Vadalia
		Travelled to Ahmedabad
	68	Metro Wood and Engineering Works (P) Limited Ashram Road, Navangpura, Ahmedabad 9. Mr. G.V. Shah, Managing Director Mr. R.M. Patel, Director Melamine and Fibre Boards Limited Kalol, North Gujarat.
	69	Furniture Mart, Ahmedebad.
	70	Office of the Industries Commission Multi-storeyed Building, Lal Darwaja, Ahmedabad 1. Mr. N.M. Soparkar, Joint Director Mr. G.G. Dave, Engineer
		Travelled to Bombay
Maharashtra		
14th January	71	Maharashtra State Co-operative Bank (MSCB) Sir Vithaldas Thackersey Memorial Building, 9 Bakehouse Lane, Fort, Bombay.
15th January	72	Economic and Political Weekly
	73	Bombay University Library
16th January	74	Maharashtra Electricity Board Mercantile Bank Building, Mahatma Gandhi Road, Bombay.
17th January	75	Godrej (furniture firm) Kalvedevi Road, Bombay 2.
	76	Kamdar (P) Limited (furniture firm) Industrial Building, Bombay 1.

Maharashtra

17th January

77 Sachivalaya, Bombay.

Mr. Joshi, Secretary for forests
Mr. Naik

Travelled to Latur, via Sholapur

18th January

78 Co-operative Oil Industries Limited (COI) Latur.

Mr. S.T. Nade, Chairman Osmanabad District Central Co-operative Bank
Mr. P.V. Parekh, Production manager (COI)
Mr. Chavan, Manager (COI)
Mr. T. Patil, Chairman (COI)
Mr. K.S. Sonaone, Director (COI)

Travelled to Bombay

21st January

79 CIBA of India Limited
Plastics Division, Esplanade House,
29 Waudby Road, Fort Bombay.

Mr. O. Geng, Director
Mr. Rao, Sales Officer

80 Nash and Company, Abdul Rehman Street, Bombay.

Mr. Z. Nalwalla
Mr. Rao of CIBA

81 M/s Variety Plywood
193 Manuber Mansion, Dr. B. Ambekar Road,
Dadar, Bombay.

Mr. J. Nainsey
Mr. Rao of CIBA

22nd January

82 Telecon Industries (P) Limited
61 Dr. S.S. Ram Road, Parel, Bombay 12.

83 at hotel
Srinivas Brothers
(Agents for Nuchem Plastics Limited of Faridabad)
316 Neelar, 3rd Floor, 108 Worlisea Face Road, Bombay 18.

Mr. J.N.S. Murthy

Madhya Pradesh

Travelled to Indore

84 Malwa Economic Development Society, Plot 85, Industrial Estate, Polo Ground, Indore 3.

Mr. D.H. Eadie, Technical Adviser

23rd January

85 Dewas Flour and De-oiled Cake Factory, Dewas.

Mr. V.M. Bhandari, Director
Mr. A.G. Khanolkar, Production Manager

86 Malwa Vanaspati Mills, Indore.

Mr. Mohatta, Proprietor, (at residence)

Madhya Pradesh

24th January	87	Malwa Vanaspati Mills, Indore. Mr. Sethi, Senior Chemist
26th January		Travelled to New Delhi

Delhi

27th January	88	East India Services and Marketing UCO Bank Building (3rd Floor), Parliament Street, New Delhi. (Birla Brothers, Private Limited) Mr. B.P. Jain, Vice President
28th January	89	Ministry of Food and Agriculture, Krishi Bhavan Mr. Ram Saran, Additional Economics and Statistics Adviser Mr. S.S. Chanhan, Assistant Agricultural Commissioner
	90	Mr. J.K. Jain, Joint Commissioner, Irrigation Division.
29th January	91	Directorate General of Technical Development Ministry of Industrial Development, Udyog Bhavan New Delhi. Mr. J. Singh Matharu, Development Officer (Timber)
	92	National Building Organisation Nirman Bhavan, Maulana Azad Road, New Delhi. Dr. Rabinder Singh
30th January	93	Office of the Economic Adviser to the Government of India. Udyog Bhavan, Mina Azad Road-1. Dr. V. Agnihotry Mr. S.H. Ompraka
31st January	94	The Federation of the Plywood Industry 4E/13 Jhandewalan Extension, New Delhi 1. Mr. G.B. Deshpande, Secretary
	95	National Timber Trading Company 7/2 Deshbandhu Gupta Road, Pahaganj, Delhi.
	96	Harichand Bhagatram Deshbandhu Gupta Road, Pahaganj, Delhi.
	97	Gokalchand Jagarmath Nahar Deshbandhu Gupta Road, Pahaganj, Delhi.
1st February	98	Hyderabad Allwyn Metal Works Limited Sanatnagar, Hyderabad, 18. (pre-fabricated housing) Mr. Mohinder Singh, Contracts Manager

Delhi

3rd February	99	British High Commission Economic and Commercial Division, Chanakyapuri, New Delhi 21. A.G. Read, First Secretary (Labour)
3rd-4th February		Travelled to London

APPENDIX II

TABLE 1

Production of Groundnuts by Main Producing States 1963-64 to 1967-68

		1963-64	1964-65	1965-66	1966-67	1967-68	Area irrigated 1965-66 '000 hectares.
	Andhra Pradesh						
1	A : Area '000 hectares	981.6	1,091.9	1,239.4	1,188.7	1,308.2	89
2	P : Production '000 tonnes	754.0	910.6	630.0	819.2	998.6	
3	Y : Yield per hectare kgs/hectare	768	834	508	689	763	
	Gujarat						
4	A	1,847.1	2,046.3	2,024.4	1,992.4	2,009.1	5
5	P	1,266.6	1,561.2	919.8	925.9	1,457.7	
6	Y	686	763	454	465	726	
	Madhya Pradesh						
7	A	433.5	464.5	595.2	477.8	462.5	1
8	P	290.6	342.6	265.4	159.3	377.7	
9	Y	670	738	446	333	817	
	Madras						
10	A	913.6	929.4	895.6	911.0	908.7	115
11	P	1,108.5	950.7	887.0	896.6	884.7	
12	Y	1,213	1,023	990	984	974	
	Maharashtra						
13	A	1,135.9	1,071.4	1,053.1	1,057.5	1,044.4	17
14	P	780.5	805.1	450.1	470.4	743.9	
15	Y	687	751	427	445	712	
	Mysore						
16	A	891.8	871.0	804.0	779.4	777.7	-
17	P	539.4	629.0	393.0	440.1	502.9	
18	Y	605	722	489	565	647	
	Uttar Pradesh						
19	A	297.9	328.7	370.8	409.8	414.3	1
20	P	267.4	343.0	349.9	312.0	308.0	
21	Y	898	1,044	944	761	743	
22	All India G.N. Area	6,886.4	7,216.3	7,428.1	7,299.1	7,553.6	244
23	All India Food Grains						24,064
24	All India Crops						30,922

Source: Area, Production and Yield of Principal Crops in India. 1949-50 to 1967-68. Summary Tables. Directorate of Economics and Statistics, Ministry of Food, Agriculture, Community Development and Cooperation. Government of India 1968.

- Nil or negligible

TABLE 2

List of Capital Items Involving Sterling Costs

	Items	Prices of items		
		ex factory UK or in sterling	c.i.f. Bombay or in India	
		£ a	£ b	Rupees c
1	Plant including boiler and electric motors	79,800		
2	Caul plate cooler	6,530		
3	Controls console	1,570		
4	Working manuals	2,000		
5	Total; c.i.f. as stated by manufacturers	89,900	99,030	1,782,540
6	Spare parts for plant(1) 10% of total in row 5		9,900	178,200
7	Testing equipment; c.i.f. at 40% of cost	760	1,080	19,080
8	Spare parts for item 7(1) 20% of item 7		210	3,780
9	Electrical distributor(1) transformer & switchgear	-	7,000	126,000
10	Total rows 5 +7 +9		107,090	1,927,620
11	Boiler and oil tank		4,000	72,000
12	Spare parts for boiler etc. 10% of item 11		400	7,200
13	Total equipment excluding boiler row 10-11		103,090	1,855,620
14	Total spare parts excluding those of boiler row 6 + 8 - 12		9,710	174,780
15	Commissioning engineer 3 months	4,180(2)	740(3)	75,240
16	TPI Experimental Officer 6 months salary, allowances, fare	2,260	?	?
17	Technical manager 9 months	5,450(4)	?	?

Source: Specification by Gardners of Gloucester.

Footnotes: Figures in this table are rounded.

(1) Only c.i.f. values were stated for these items.

(2) 92 days at £8 per day in India; residue at £32 per day + £500 travel expenses paid in UK.

(3) Rounded and included in col a.

(4) 275 days at £18 per day + travel expenses.

- - - - - Subtotal

TABLE 3

Estimated Capital Costs for Plant in India at Sites 1, 4 and 6, including Local Costs

	Items	Site 1			Site 4			Site 6		
		Foreign exchange	Local currency	Total	Foreign exchange	Local currency	Total	Foreign exchange	Local currency	Total
		Rs. a	Rs. b	Rs. c	Rs. d	Rs. e	Rs. f	Rs. g	Rs. h	Rs. i
1	Land	-	-	-	-	-	-	-	-	-
2	Buildings	-	110,400	110,400	-	248,840	248,840	-	152,000	152,000
3	Plant and equipment excluding boiler (row 13, Table 2)	1,855,620	-	1,855,620	1,855,620	-	1,855,620	1,855,620	-	1,855,620
4	Boiler and tank				72,000	-	72,000			
5	Spare parts (rows 12 and 14, Table 2)	174,780	-	174,780	181,980	-	181,980	174,780	-	174,780
6	Taxes on imported goods: (import duty 27.5% on rows 3, 4 and 5)	-	558,360	558,360	-	580,140	580,140	-	558,360	558,360
7	Commissioning (row 15, Table 2)	61,920	13,320	75,240	61,920	13,320	75,240	61,920	13,320	75,240
8	Preliminary expenses (rows 16 and 17, Table 2)	...	...	138,780	...	...	138,780	...	...	138,780
9	Allowance for unforeseen costs (10% of items 2 to 5 and 7)	...	...	321,604	...	...	243,368	...	...	225,764
10	Total, rows 1 to 9	...	...	3,134,784	...	...	3,395,968	...	...	3,180,544
11	Total, rows 1 to 5, 7 and 9	...	...	2,437,644	...	...	2,677,048	...	...	2,483,404
12	Total, rows 1 to 7, 9 and row 2, Table 22 (resin plant)	...	...	3,013,230						
	WORKING CAPITAL									
13	3 shift, 86% P.E. (Tables 4, 5 and 6; column c.)	-	988,366	988,366	-	1,058,129	1,058,129	-	1,017,183	1,017,183
14	3 shift, 86% P.E. (Table 4; column d.)	-	422,163	422,163						
15	1 shift, 86% P.E. (Table 7; column c.)	-	344,785	344,785						
16	1 shift, 86% P.E. (Table 7; column d.)	-	149,150	149,150						
17	1 shift, 70% P.E. (Table 8; column d.)	-	126,367	126,367						
18	1 shift, 70% P.E. (Table 9; column c.)	-	156,126	156,126						

Footnotes:

- Nil or negligible
... Not available
P.E. = Plant efficiency

TABLE 4

Site 1 Andhra Pradesh: Cost Structure of Plant to Produce 360 Boards (13 metric tons) Per day on three shifts. 86% Plant efficiency

Output per year of 300 days: 3,456,000 sq.ft.
321,070 sq.m.
3,919 metric tons

Board characteristics: ½ in x 8' x 4 ft; 19 m.m. x 2.44 x 1.22; Density 40 lb. per cu.ft. 641 kg. per cu.m.

METRIC TONS

	Item	Quantity or number	Costs, Rupees per year: Purchased resin, Rail delivery	Costs, Rupees per year: Resin made in plant, Truck delivery	Prices or rates	Remarks
	a	b	c	d	e	f
1	RAW MATERIALS Groundnut husks	6,000 tons	55,500	55,500	selling Rs. 8 buying Rs. 10 per ton	1.5 tons per ton of board (rounded) 2,250 tons at Rs. 8
2	Resin	344.9 tons	1,899,054	1,467,205	Rs. 5438 + rail freight or Rs. 4254 per ton	8.8% of board weight
3	Hardener	2.16 tons	5,092	5,092	Rs. 2,250 per ton + rail freight	0.625% of resin weight
4	Insecticide	43.1 tons	301,700	301,700	Rs. 7000 per ton local price	1.1% on board weight
5	Wax	21.6 tons	29,217	29,217	Rs. 1276 per ton + rail freight	0.55% on board weight
6	TOTAL		2,290,563	1,858,714		
	PERSONNEL					
7	Technical Manager	1	9,000	9,000	Rs. 750 per month	
8	Foreman	3	18,000	18,000	Rs. 500 per month	
9	Service Engineer	1	3,600	3,600	Rs. 300 per month	
10	Semi-skilled labour	9	21,600	21,600	Rs. 200 per month	
11	Unskilled labour	45	54,000	54,000	Rs. 100 per month	
12	Clerk	3	14,400	14,400	Rs. 400 per month	Estimated wage rate
13	Typist	3	18,000	18,000	Rs. 500 per month	Estimated wage rate
14	Additional Labour costs		14,040	14,040	15% on items 9 to 11 and 12	Provident fund 8%; bonus 4%; state insurance 3%.
15	TOTAL		152,640	152,640		
	SERVICES					
16	Electricity Demand charge	300 kva	45,000	45,000	Rs. 12.50 per kva per month	As stated by firm
17	Energy charge	2,230.26 mwh	200,723	200,723	Rs. 0.09 per kwh	
18	Steam	4,899 tons	57,600	57,600	Rs. 8 per hour	0.6804 tons per hour
19	Water	1,309,000 L	576	576	Rs. 0.44 per 1000 litres	182 L per hour
20	TOTAL		303,899	303,899		
	OTHER COSTS					
21	Insurance: building		276	276	0.25% on value of building	
22	plant		9,137	9,137	0.45% on value of plant and spares	
23	stock		1,717	1,447	0.75% on value of stock	Stock equal to 1 months' costs for raw material, personnel and service
24	Repairs and Maintenance		206,867	206,867	7.5% on operating cost of col. c.	Operating Costs: Row 6 + 15 + 20 to 23
25	Interest on Working Capital		98,837	42,216	10% on 4 months' operating costs col. c. - on 2 months' operating costs col. d.	Operating Costs: Row 6 + 15 + 20 to 24
26	Unforeseens		153,197	128,760	5% of rows 1-23	Conventional allowance
27	TOTAL		470,031	388,703		
	DEPRECIATION					
28	Machinery		185,562	185,562	10% on initial value of plant	Roughly equal to 20% and 5% respectively on diminishing balance
29	Buildings		2,429	2,429	2.2% of initial value	
30	TOTAL		187,991	187,991		
31	TOTAL EX FACTORY COST		3,405,124	2,891,947		
32	Cost of transport		207,094	207,094		
33	Dealer's mark up		510,769	433,792	15% of ex factory cost	
34	TOTAL DELIVERED COST		4,122,987	3,532,833		
35	Row 34 less depreciation		3,934,996	3,344,842		
36	Cost per sq. meter (incl. depreciation)		Rs. 12.84	Rs. 11.00		Calculated on row 34
37	Cost per sq. ft. (incl. depreciation)		Rs. 1.19	Rs. 1.02		Calculated on row 34

- - - - - Subtotal

TABLE 5

Site 4 Gujarat: Cost Structure of Plant to Produce 300 Boards (13.9m metric tons) per day on 3 shifts; Plant efficiency = 85%

Output per year of 300 days: 3,456,000 sq.ft.
321,000 sq.m.
3,919 metric tons

Board Characteristics: 9' x 4' x ¾"; 2.44m x 1.22m x 19mm; Density = 40lb/cu.ft, 641 kg/cu.m.

METRIC TONS

	Item	Quantity or number	Costs: Rupees per year - Purchased resin	Prices or rates	Remarks
	a	b	c	d	e
	RAW MATERIALS				
1	Groundnut husks	6,000 tons	300,000	Rs. 50 per ton (buying price)	1.5 tons per ton of board (rounded up)
2	Resin	344.9 tons	1,906,814	Rs. 5438 per ton + rail freight	8.8% of board weight
3	Hardener	2.16 tons	5,169	Rs. 2250 per ton + rail freight	0.625% of resin weight
4	Insecticide	43.1 tons	301,700	Rs. 7,000 per ton, local price	1.1% of board weight
5	Wax	21.6 tons	29,765	Rs. 1,276 per ton, + rail freight	0.55% of board weight
6	TOTAL, rows 1 to 5	2,543,448			
	PERSONNEL				
7	Technical Manager	1	10,800	Rs. 900 per month	
8	Foreman	3	10,800	Rs. 300 per month	
9	Typist	3	10,800	Rs. 300 per month	Estimated wage rate
10	Clerk	3	10,800	Rs. 300 per month	Estimated wage rate
11	Service Engineer	3	10,800	Rs. 300 per month	1 service engineer per shift
12	Semi-skilled labour	9	10,800	Rs. 100 per month	
13	Unskilled labour	48	43,200	Rs. 75 per month	Includes 1 boiler-man per shift
14	Additional labour costs		16,173	8% on item 7; 15½% on items 8 to 13	Provident fund 8%; bonus 4%; state insurance 3½%.
15	TOTAL, rows 7 to 14		124,173		
	SERVICES				
16	Electricity - demand charge	300 kVA	34,800	Rs. 9.6 per kVA per month	Average based on local tariff
17	Electricity - energy charge	2,230.26 MWh	145,812	Rs. 0.065 per kWh	Average based on local tariff
18	Oil for boiler	81.1 lb. per hr	65,090	Rs. 245.75 per ton	
19	Water	1,309,000 litres	576	Rs. 0.44 per 1,000 litres	182 litres per hour
20	TOTAL, rows 16 to 19	246,278			
	OTHER COSTS				
21	Insurance: buildings		3,733	1.5% of value of buildings	
22	" : plant		31,644	1.5% of value of plant and spares	
23	" : stock		3,642	1.5% of value of stock	Stock = 1 month's costs for raw materials, personnel and services
24	Repairs and Maintenance		221,469	7.5% of operating costs	Operating Costs = Rows 6 + 15 + 20 to 23
25	Interest on Working Capital		95,232	9.0% of four months operating costs	Here operating costs to also include row 24
26	Unforeseens		163,481	5.0% of sum of rows 6, 15 and 20-25	
27	TOTAL, rows 21 to 26		519,201		
	DEPRECIATION				
28	Machinery		192,762	10% on initial value	)Roughly equal to 20% and 5% respectively
29	Buildings		5,474	2.2% on initial value	)on diminishing balance
30	TOTAL, rows 28 and 29		198,236		
31	TOTAL EX-FACTORY COST		3,631,336		Sum of rows 6, 15, 20, 27 and 30
32	Cost of Transport		308,648		See table 11
33	Dealers mark-up		544,700	15% of total ex-factory cost	
34	TOTAL DELIVERED COST		4,484,684		
35	TOTAL DELIVERED COST (EXCLUDING DEPRECIATION)		4,286,448		
36	Interest on loan capital (to be set against profit)		90,000	9.0% on Rs. 1,000,000	Loan from Investment Corporation
37	Cost per Sq. Metre (incl. depreciation)		Rs. 13.97		)Calculated on row 34
38	" " Sq. Foot (" ")		Rs. 1.30		
39	Cost per Sq. Metre (excl. depreciation		Rs. 13.35		)Calculated on row 35
40	" " Sq. Foot (" ")		Rs. 1.24		

- - - - - - - Subtotal

TABLE 6

Site 6 Maharashtra: Cost Structure of Plant to Produce 360 Boards (13.06 metric tons) per day on three shifts: Plant efficiency = 86%

Output per year of 300 days: 3,456,000 sq.ft.
321,070 sq.m.
3,919 metric tons

Board Characteristics: 8' x 4' x ¾"; 2.44m x 1.22m x 19mm; Density = 40 lb/cu.ft., 641 kg/cu.m.

METRIC TONS

	Item a	Quantity or number b	Costs: Rupees per year - Purchased resin c	Prices or Rates d	Remarks e
	RAW MATERIALS				
1	Groundnut husks	6,000 tons	240,000	RS. 40 per ton	1.5 tons per ton of board
2	Resin	344.9 tons	1,893,467	Rs.5438 per ton + rail freight	8.8% of board weight
3	Hardener	2.16 tons	5,037	Rs. 2250 per ton + rail freight	0.625% of board weight
4	Insecticide	43.1 tons	301,700	Rs. 7000 per ton, local price	1.1% of board weight
5	Wax	21.6 tons	28,825	Rs. 1276 per ton + rail freight	0.55% of board weight
6	TOTAL, rows 1 to 5		2,469,029		
	PERSONNEL				
7	Technical Manager	1	14,400	Rs. 1,200 per month	
8	Foreman	3	7,200	Rs. 200 per month	
9	Typist	3	10,800	Rs. 300 per month	Estimated rate
10	Clerk	3	10,800	Rs. 300 per month	Estimated rate
11	Service Engineer	1	4,800	Rs. 400 per month	
12	Semi-skilled labour	9	13,500	Rs. 125 per month	
13	Unskilled labour	45	40,500	Rs. 75 per month	
14	Additional labour costs		10,512	12% on items 8 to 13	Provident fund 8%; Bonus 4%; State Insurance not yet applicable.
15	TOTAL, rows 7 to 14		112,512		
	SERVICES				
16	Electricity - demand charge	300 kVA	34,200	Rs. 9.50 per kVA per month	)
17	Electricity - energy charge	2,230.26 MWh	100,362	Rs. 0.045 per kWh	)as stated by firm
18	Steam	4,899 tons	85,732	Rs.17.50 per ton	]
19	Water	1,309,000 litres	576	Rs. 0.44 per 1000 litres	Estimated price
20	Total, rows 16 to 19		220,870		
	OTHER COSTS				
21	Insurance: buildings		2,280	1¼% of value of buildings	
22	" : plant		30,456	1¼% of value of plant and spares	
23	" : stock		3,503	1¼% of value of stock	Stock = 1 month's costs for raw materials personnel & services
24	Repairs & maintenance		212,899	7½% of operating costs	Operating Costs = Rows 6 + 15 + 20 to 23
25	Interest on working capital		66,461	8½% of four months' operating costs	Here operating costs to include row 24
26	Unforeseens		156,900	5% of sum of rows,6, 15 and 20 to 25	
27	TOTAL, rows 21 to 26		492,499		
	DEPRECIATION				
28	Machinery		185,562	10% of initial value	)roughly equal to 20% and 5% respectively on diminishing
29	Buildings		3,344	2.2% on initial value	)balance
30	TOTAL, rows 28 and 29		188,906		
31	TOTAL EX-FACTORY COST		3,483,816		
32	Cost of Transport		218,416		See table 11
33	Dealers' mark-up		522,573	15% of total ex-factory cost	
34	TOTAL DELIVERED COST		4,224,805		
35	TOTAL DELIVERED COST (EXCL. DEPRECIATION		4,035,899		
36	Cost per Sq. Meter (incl. depreciation)		Rs. 13.16		))Calculated from row 34
37	Cost per Sq. foot (incl. depreciation)		Rs. 1.22		
38	Cost per Sq. meter (excl. depreciation)		Rs. 12.57		))Calculated from row 35
39	Cost per Sq. foot (excl. depreciation)		Rs. 1.17		

- - - - - Subtotal

TABLE 7

Site 1 Andhra Pradesh: Cost structure of plant to produce 120 boards (4.35 metric tons) per day on one shift; Plant efficiency = 80%

Output per year of 300 days: 1,152,000 sq.ft.
107,020 sq.m.
1,306 metric tons

Board characteristics: 8' x 4' x ⅜", 2.44m. x 1.22m. x 10mm., Density 40 lb. per cu.ft., 641 kg. per cu.m.

METRIC TONS

	Item	Quantity/ Number	Costs, Rupees per annum: Purchased resin, Rail delivery, No import duty	Costs, Rupees per annum: Resin made in plant, Truck delivery, Import duty included	Prices/Rates	Remarks
	a	b	c	d	e	f
	RAW MATERIALS					
1	Groundnut husks	2,000 tons	16,000	16,000	Selling Rs.8 per ton	1.5 tons per ton of board (rounded)
2	Resin	115.0 tons	633,018	491,138	Rs. 5,438 per ton + freight; or Rs.4,272 per ton	8.8% of board weight
3	Hardener	0.72 tons	1,698	1,698	Rs. 2,250 per ton + rail freight	0.625% of resin weight
4	Insecticide	14.4 tons	100,800	100,800	Rs. 7,000 per ton, local price	1.1% on board weight
5	Wax	7.2 tons	9,739	9,739	Rs. 1,276 per ton + rail freight	0.55% on board weight
6	TOTAL, rows 1 to 5		761,255	619,375		
	PERSONNEL					
7	Technical Manager	1	9,000	9,000	Rs. 750 per month	
8	Foreman	1	6,000	6,000	Rs. 500 per month	
9	Typist	1	6,000	6,000	Rs. 500 per month	
10	Clerk	1	4,800	4,800	Rs. 400 per month	
11	Service Engineer	1	3,600	3,600	Rs. 300 per month	
12	Semi-skilled labour	3	7,200	7,200	Rs. 200 per month	
13	Unskilled labour	15	18,000	18,000	Rs. 100 per month	
14	Additional labour costs		5,040	5,040	15% on items 10 to 13	Provident fund 8%, bonus 4%, State insurance 3%
15	TOTAL, rows 7 to 14		59,640	59,640		
	SERVICES					
16	Electricity; demand charge	300 kVA	45,000	45,000	Rs. 12.50 per kVA per month	As stated by firm
17	Electricity; energy charge	743.42 MWh	66,908	66,908	Rs. 0.09 per kWh	As stated by firm
18	Steam	1,633 tons	19,188	19,188	Rs. 11.75 per ton	0.6804 tons per hour
19	Water	436,333 litres	192	192	Rs. 0.44 per 1,000 litres	182 litres per hour (approx)
20	TOTAL, rows 16 to 19		131,288	131,288		
	OTHER COSTS					
21	Insurance: Building		276	276	0.25% on value of building	
22	Insurance: Plant		9,137	11,650	0.45% on value of plant and spares	Import duty at 27½% in col. D.
23	Insurance: Stock		595	506	0.75% on value of board stock	Stock = 1 mths cost of raw material, personnel, services.
24	Repairs and Maintenance		72,164	72,164	7.5% of operating costs of col. c.	Operating costs = rows, 6, 15, 20-23.
25	Interest on Working capital		34,478	14,915	10% of 4 months costs (col. c), 2 months costs (col d)	Here, costs are rows 1 - 24 inclusive.
26	Unforeseens		53,442	45,491	5% of rows 6, 15, 20-25	
27	TOTAL, rows 21 to 26		170,092	145,002		
	DEPRECIATION					
28	Machinery		123,708	157,728	6 2/3% on initial value (c.i.f. + import duty in col. d).	Assumed life 15 years
29	Building		2,429	2,429	2.2% of initial value	Assumed life 45 years
30	TOTAL, rows 28 and 29		126,137	160,157		
	TOTAL EX FACTORY COST		1,248,412	1,115,462		Sum of rows 6, 15, 20, 27, 30.
32	Cost of transport		69,031	69,031		See table 11
33	Dealers' mark-up		187,262	167,319	15% of total ex-factory cost	
34	TOTAL DELIVEPEL COST		1,504,705	1,351,812		Sum of rows 31, 32, 33
35	ROW 34, LESS DEPRECIATION		1,378,568	1,191,655		
36	Cost per Sq.Meter (inc. depreciation)		Rs.14.06	Rs.12.63		
37	Cost per Sq.foot " "		Rs. 1.31	Rs. 1.17		
38	Income in 12 months			1,612,800	Rs. 1.40 per sq. foot	This and row 39 are req'd for DCF calculations
39	Profit in 12 months			421,145		Row 38 - row 35
40	Income in 10 months			1,344,000	Rs. 1.40 per sq. foot	This and row 41 are req'd for DCF calculations
41	Profit in 10 months			350,954		Row 40 - 5/6 of row 35

- - - - - Subtotal

TABLE 8

Site 1 Andhra Pradesh: Structure of plant to produce 88 boards (3.55 metric tons) per day on one shift, assuming 70% plant efficiency

Output per year of 300 days: 940,800 sq.ft.
87,400 sq.m.
1,066 metric tons

Board characteristics: 8' x 4' x ¾", 2.44m. x 1.22m. x 19mm., Density 40 lb/cu.ft., 641 kg/cu.m.

METRIC TONS

	Item	Quantity Number	Costs, Rupees per annum: Purchased resin rail delivery no import duty	Costs, Rupees per annum: Resin made in captive plant, truck delivery; with import duty	Prices/Rates	Remarks
	a	b	c	d	e	f
1	RAW MATERIALS Groundnut Husks	1,600 tons	12,800	12,800	Selling Rs. 8 per ton	1.5 tons per ton of board
2	Resin	93.8 tons	516,516	400,746	Rs. 5,438/ton + rail freight; or Rs. 4,272/ton	8.8% of board weight
3	Hardener	0.586 tons	1,382	1,382	Rs. 2,250/ton + rail freight	0.625% of resin weight
4	Insecticide	11.73 tons	82,082	82,082	Rs. 7,000 per ton, local price	1.1% on board weight
5	Wax	5.86 tons	7,930	7,930	Rs. 1,276/ton + rail freight	0.55% on board weight
6	TOTAL rows 1 to 5		620,710	504,942		
	PERSONNEL					
7	Technical Manager	1	9,000	9,000	Rs. 750 per month	
8	Foreman	1	6,000	6,000	Rs. 500 per month	
9	Typist	1	6,000	6,000	Rs. 500 per month	
10	Clerk	1	4,800	4,800	Rs. 400 per month	
11	Service Engineer	1	3,600	3,600	Rs. 300 per month	
12	Semi-skilled labour	3	7,200	7,200	Rs. 200 per month	
13	Unskilled labour	15	18,000	18,000	Rs. 100 per month	
14	Additional labour costs		5,040	5,040	15% on items 10-13	Provident fund 8%, bonus 4%, state insurance 3%
15	TOTAL rows 7 to 14		59,640	59,640		
	SERVICES					
16	Electricity: Demand charge	300 kVA	45,000	45,000	Rs. 12.50/kVA, per month	As stated by firm
17	Electricity: Energy charge	650 MWh	58,500	58,500	Rs. 0.09 per kWh	As stated by firm
18	Steam	1,429 tons	16,791	16,791	Rs. 11.75 per ton	0.5954 tons per hour
19	Water	382,200 litres	168	168	Rs. 0.44 per 1000 litres	159 litres per hour, approx.
20	TOTAL rows 16 to 19		120,459	120,459		
	OTHER COSTS					
21	Insurance: Building		276	276	0.25% on value of building	
22	" Plant		9,137	11,649	0.45% on value of plant and spares	Import duty at 27½% included in col. d only
23	" Stock		501	428	0.75% on value of board stock	Stock = 1 month's cost of raw materials, personnel, services
24	Repairs and Maintenance		60,804	60,804	7.5% of operating costs of col. c	Operating costs = sum of rows 6, 15, 20 - 23
25	Interest on Working Capital		29,051	12,637	10% of 4 months operating costs for col. c 2 months for col. d	Here row 24 is also included in operating costs
26	Unforeseens		45,029	38,542	5% of rows 6, 15 and 20-25	
27	TOTAL rows 21 to 26		144,798	124,336		
	DEPRECIATION					
28	Machinery		123,708	157,728	6 2/3% on initial value (c.i.f. + import duty in col. d)	Assumed life 15 years
29	Building		2,429	2,429	2.2% of initial value	Assumed life 45 years
30	TOTAL rows 28 and 29		126,137	160,157		
31	TOTAL EX-FACTORY COST		1,071,744	969,534		Sum of rows 6, 15, 20, 27, 30
32	Cost of transport		56,376	56,376		See table 11
33	Dealer's mark-up		160,762	145,430	15% of ex-factory cost	
34	TOTAL DELIVERED COST		1,288,882	1,171,340		Sum of rows 31, 32, 33
35	ROW 34, LESS DEPPECIATION		1,162,745	1,011,183		
36	Cost per Sq. Metre (inc. depreciation)		Rs.14.75	Rs.13.40		
37	Cost per sq.foot " "		Rs. 1.37	Rs. 1.25		
38	Income in 12 months		1,317,120	1,317,120	At Rs. 1.40/sq.ft.	
39	Profit in 12 months		154,375	305,937		Row 38 - Row 35
40	Income in 10 months		1,097,600	1,097,600	At Rs. 1.40/sq.ft.	
41	Profit in 10 months		128,646	254,948		Row 40 - 5/6 of Row 35

- - - - - Subtotal

TABLE 9

Site 1 - Andhra Pradesh: Structure of plant to produce 98 boards (3.55 metric tons) per day on one shift, utilising wood chips and assuming 70% plant efficiency

Output per year of 300 days: 940,800 sq.ft.
87,400 sq.m.
1,066 metric tons

Board characterisitics:- 8' x 4' x ¾", 2.44m. x 1.22m. x 19mm., Density 40 lb/cu.ft. 641 kg/cu.m.

METRIC TONS

	Item a	Quantity/ Number b	Costs Rupees per annum (Resin made in plant, truck delivery) Import duty included c	Prices/Rates d	Remarks e
	RAW MATERIALS				
1	Timber	2,400 tons	84,000	Selling Rs. 35 per ton	2.25 tons per ton of board
2	Resin	93.8 tons	400,748	Rs. 4,272 per ton	8.8% of board weight
3	Hardener	0.586 tons	1,382	Rs. 2,250 per ton plus rail freight	0.625% of resin weight
4	Insecticide	11.73 tons	82,082	Rs. 7,000 per ton, local price	1.1% on board weight
5	Wax	5.86 tons	7,930	Rs. 1,276 per ton plus rail freight	0.55% on board weight
6	TOTAL, rows 1 to 5		576,142		
	PERSONNEL				
7	Technical Manager	1	9,000	Rs. 750 per month	
8	Foreman	1	6,000	Rs. 500 per month	
9	Typist	1	6,000	Rs. 500 per month	
10	Clerk	1	4,800	Rs. 400 per month	
11	Service Engineer	1	3,600	Rs. 300 per month	
12	Semi-skilled labour	3	7,200	Rs. 200 per month	
13	Unskilled labour	20	24,000	Rs. 100 per month	
14	Additional labour costs		5,940	15% on items 10 to 13	Provident fund 8%, bonus 4%, state insurance 3%
15	TOTAL, rows 7 to 14		66,540		
	SERVICES				
16	Electricity: Demand Charge	467.5 kVA	70,125	Rs. 12.50/kVA, per month	As stated by firm
17	Electricity: Energy Charge	1,014 MWh	91,231	Rs. 0.09 per kWh	As stated by firm
18	Oil	108.6 tons	26,686	Rs. 245.75 per tonne	10.5 gal. per hour
19	Steam	1,429 tons	16,791	Rs. 11.75 per ton	0.5954 tons per hour, average
20	Water	382,200 litres	168	Rs. 0.44 per 1,000 litres	159 litres per hour, approx.
21	TOTAL, rows 16 to 20		205,003		
	OTHER COSTS				
22	Insurance: Building		276	0.25% on value of building	
23	" : Plant		15,057	0.45% on value of plant and spares	Including import duty at 27½%
24	" : Stock		530	0.75% on value of board stock	Stock = 1 month's cost of raw materials, personnel, services
25	Repairs and Maintenance		73,210	See footnote	See footnote
26	Interest on Working Capital		15,613	10% of 2 months' operating costs	Operating costs = sum of rows 6,15,21-24, but for calculation of row 26, row 25 was also included
27	Unforeseens		47,619	5% of rows 6, 15 and 21 - 26	
28	TOTAL, rows 22 to 27		152,305		
	DEPRECIATION				
29	Machinery		199,803	6 2/3% on initial c.i.f. value, import duty paid	Assumed life 15 years
30	Building		2,429	2.2% on initial value	Assumed life 45 years
31	TOTAL, rows 29 and 30		202,232		
32	TOTAL EX-FACTORY COST		1,202,222		Sum of rows 6, 15, 21, 28, 31
33	Cost of transport		56,376		See table 11
34	Dealer's mark-up		180,333	15% of ex-factory cost	
35	TOTAL DELIVERED COST		1,438,931		Sum of rows 32, 33, 34
36	ROW 35, LESS DEPRECIATION		1,236,699		
37	Cost per Sq. Metre (Including depreciation)		Rs. 16.46		
38	Cost per Sq. ft. (Including depreciation)		Rs. 1.53		
39	Cost per Sq. Metre (Excluding depreciation)		Rs. 14.15		
40	Cost per sq. ft. (excluding depreciation)		Rs. 1.31		

Footnote - row 25, cols. d and e:- To allow direct comparisons to be made with Table 8, the figure of 73,210 is based on costs incurred if the resin were to be purchased ready-made and delivered by rail; in this instance row 2 has been taken as 516,516, row 23 as 11,809 and row 24 as 602, and the final figure of 73,210 represents 7.5% of operating costs (i.e. rows 6, 15, 21-24), allowing for the foregoing alterations.

TABLE 10

Rail Transport Costs of Raw Materials from Sources to Sites

	Factory Site	Distance from Source (Bombay) (1)	Resin					Hardener (4)					Wax					Distance from Source (Kandla)	Formaldehyde				
			Requirements 3 Shifts	Costs				Requirements 3 Shifts	Costs				Requirements 3 Shifts	Costs					Requirements 3 Shifts	Costs			
				A (2)		B (3)			A		B			A		B				A		B	
				Tariff	Total	Tariff	Total		Tariff	Total	Tariff	Total		Tariff	Total	Tariff	Total			Tariff	Total	Tariff	Total
		KM	'000 Kg	RS/ 100 Kg	RS	RS/ 100 Kg	RS	'000 Kg	RS/ 100 Kg	RS	RS/ 100 Kg	RS	'000 Kg	RS/ 100 Kg	RS	RS/ 100 Kg	RS	km	'000 Kg	RS/ 100 Kg	RS	RS/ 100 Kg	RS
1	Site 1 Kurnool Andhra Pradesh	580	344.9	7.32	25,247	6.81	23,488	2.16	10.75	232	9.72	210	21.6	7.66	1,655	6.98	1,508	1,398	591.6	15.11	89,391	13.74	81,286
2	Site 2 Adoni Andhra Pradesh	580	344.9	7.32	25,247	6.81	23,488	2.16	10.75	232	9.72	210	21.6	7.66	1,655	6.98	1,508	-	-	-	-	-	-
3	Site 3 Davangere Mysore	777	344.9	9.36	32,283	8.70	30,006	2.16	13.78	298	12.45	269	21.6	9.81	2,119	8.93	1,929	-	-	-	-	-	-
4	Site 4 Jamnagar Gujarat	818	344.9	9.74	33,593	9.06	31,248	2.16	14.32	309	12.96	280	21.6	10.20	2,203	9.28	2,004	-	-	-	-	-	-
5	Site 6 Latur Maharashtra	413	344.9	5.58	19,245	5.19	17,900	2.16	8.19	177	7.40	160	21.6	5.85	1,264	5.32	1,149	-	-	-	-	-	-

SOURCES: Railway Timetable of India

Indian Railway Conference Association (Goods Tariff December 1965)

NOTES:

1. Distances are approximate
2. Column A gives costs when goods travel as 'smalls', i.e. less than wagon loads.
3. Column B gives costs when goods travel as wagon loads.
4. In the absence ot a tariff-rate specifically for ammonium chloride (the hardener) the rate for ammonium fluoride has been applied.

TABLE 11

Rail Transport Costs of Particle Board from Sites to Markets

	Markets				Sites														
	Town	Population 1961 thousands	% of total market	Volume to be sent M. tons	Site 1 Kurnool Andhra Pradesh			Site 2 Adoni Andhra Pradesh			Site 3 Davangere Mysore			Site 4 Jamnagar Gujarat			Site 6 Latur Maharashtra		
					Distance Km	Tariff Rs/100Kg	Total Rs	Distance Km	Tariff Rs/100Kg	Total Rs	Distance Km	Tariff Rs/100Kg	Total Rs	Distance Km	Tariff Rs/100Kg	Total Rs	Distance Km	Tariff Rs/100Kg	Total Rs
1	Bombay	4,152,056	34.88	1,367	580	4.40	60,148	580	4.40	60,148	777	5.62	76,825	818	5.85	79,970	413	3.37	46,068
2	Delhi	2,359,408	19.82	777	1,688	9.92	77,078	1,688	9.92	77,078	2,972	13.15	102,176	1,249	7.94	61,694	1,700	9.97	77,467
3	Madras	1,729,141	14.52	569	501	3.98	22,646	501	3.98	22,646	783	5.69	32,376	2,378	12.51	71,182	1,056	7.01	39,887
4	Bangalore	1,206,961	10.14	398	217	2.05	8,159	217	2.05	8,159	327	2.80	11,144	2,016	11.33	45,093	600	4.52	17,990
5	Hyderabad	1,251,119	10.51	412	303	2.63	10,836	303	2.63	10,836	520	4.04	16,645	1,619	9.61	39,593	346	2.93	12,072
6	Ahmedabad	1,206,001	10.13	397	1,072	7.11	28,227	1,072	7.11	28,227	1,269	8.04	31,919	326	2.80	11,116	905	6.28	24,932
7	Total	11,904,686	100.00	3,920			207,094			207,094			271,085			308,648			218,416
8	Average cost per ton						52.83			52.83			69.16			78.74			55.72

Sources: Railway timetable of India
Indian Railway Conference Association: Goods Tariff Dec. 1965
India. A Reference Annual 1967. Min. of Information & Broadcasting. Government of India.

TABLE 12

Annual Production of Wood Based Panel Products in India 1961 to 1967

	Products	1961	1962	1963	1964	1965	1966	1967	Ex-f'tory Value 1967 million Rs	Average Actual Annual Compound Rate of Growth. 1961-67	Forecasted annual growth rate 1961-1967
	Plywood:	a	b	c	d	e	f	g	h	i	j
1	Tea chest million sq. metres	9.040	9.780	10.391	9.750	10.400	9.661	10.866			
2	Commercial " " "	6.324	7.480	10.041	10.627	12.372	12.670	14.401			
3	Total " " "	15.364	17.260	20.432	20.377	22.772	22.331	25.267	125.19	8%	4%
4	Fibreboard & Insulation Board. Metric tons.	8,958	11,166	11,228	13,850	18.537	17,600	12,960	10.765	14%	26%
5	Particle Board metric tons	738	703	3,399	5,940	8,100	7,083	7,815	9.223		

Source:-

Federation of Plywood Industry, India.
Timber Trends and Prospects in the Asia - Pacific Region, FAO, Geneva 1961.

TABLE 13

Logs and Timber Wholesale Prices in Indian Markets (Close to Forests), 1961 to 1968

Quarterly and Annual averages

Rupees and n.p. per cubic foot

Specification and Market	Quarters	1961	1962	1963	1964	1965	1966	1967	1968
C.P. Teak Logs Round, over 5'	I	16.87	16.87	16.75	15.94	15.94	17.58	21.57	22.65
	II	16.87	16.87	16.75	15.94	15.93	18.41	22.23	19.75
Ballarshah, Madhya Pradesh	III	16.87	16.79	16.75	15.94	15.93	18.41	23.21	19.60
	IV	16.87	16.75	16.19	15.94	15.98	21.24	21.33	19.60
	Annual	16.87	16.82	16.61	15.94	15.94	18.91	22.08	20.40
Sal (Timber) Sleepers 7' to 9'	I	9.00	10.00	10.00	10.02	11.31	12.23	12.86	12.03
	II	9.17	10.00	10.00	10.02	11.31	12.52	-	12.03
Bareilly, Uttar Pradesh	III	9.67	10.00	10.02	10.36	11.55	12.03	12.03	14.03
	IV	10.00	10.00	10.02	10.53	12.03	12.03	12.03	14.03
	Annual	9.46	10.00	10.01	10.31	11.55	12.20	12.31	13.03
Shisham	I	7.75	8.00	8.00	8.01	9.02	9.36	10.02	13.03
	II	7.33	8.00	8.00	8.01	9.02	9.01	10.26	13.03
Bareilly, Uttar Pradesh	III	7.67	8.00	8.01	8.01	9.19	9.52	10.51	16.04
	IV	8.00	8.00	8.01	8.01	9.52	9.52	10.51	16.04
	Annual	7.69	8.00	8.01	8.01	9.19	9.35	10.32	14.54
Sal Planks	I	11.00	12.50	12.50	12.50	13.00	-	-	-
	II	11.50	12.50	12.50	12.50	12.50	-	-	-
Gauhat, Assam	III	11.83	12.50	-	12.50	11.00	-	-	-
	IV	12.50	12.50	12.49	12.50	-	-	-	-
	Annual	11.71	12.50	12.50	12.50	12.17	-	-	-
Bonsurn Planks	I	13.50	14.00	14.00	14.00	15.00	-	-	-
	II	14.00	14.00	14.00	14.00	14.50	-	-	-
Gauhat, Assam	III	14.00	14.00	-	14.00	14.00	-	-	-
	IV	14.00	14.00	14.00	14.17	-	-	-	-
	Annual	13.88	14.00	14.00	14.04	14.50	-	-	-

Source:-

Supplied by Forest Officers to
Office of Economic Adviser to Government of India

- Quotations not available

TABLE 14

A comparison of test results for groundnut shell particle board with the Indian standard for wood particle board of similar construction

	TPI Board Numbers			14	13	16	17
	Indian standards for strength and other characteristics for medium density, flat pressed, single-layer board made of wood			Standards achieved by four TPI boards made of groundnut husks containing 10% resin on husk weight			
	Characteristic	unit	value	values			
	a	b	c	d	e	f	g
1	Bulk density	kg/m^3	500 to 900	703	722	772	772
2	Variation in density	per cent	± 10	-	-	-	-
	Water absorption						
3	1 hour soaking	per cent	-	37.3	41.8	34.5	37.5
4	2 hour soaking	" "	30	-	-	-	-
5	4 hour soaking	" "	70	-	-	-	-
	Swelling						
6	Thickness	per cent	12	2.9	4.3	4.3	5.8
7	Length	" "	5	0.5	0.5	0.5	0.5
8	Width	" "	5	0.5	0.8	0.5	0.5
9	Minimum modulus of rupture, length- and widthwise	kg/cm^2	90	65	56	84	79
10	Minimum tensile strength perpendicular to surface	kg/cm^2	8	2.8	3.1	3.6	3.9
11	Thermal conductivity	k cal/hr/m^2 ^oC/m thickness	0.12	0.10			

SOURCES:

Indian Standard. Specification for Wood Particle Boards (Medium Density) for General Purposes. IS:3087-1965.

The Production of Particle Board from Groundnut Shells.
A.E. Chittenden and E.R. Palmer, Board, August-September 1964.

Particle Board from Groundnut Shells.
A.E. Chittenden and E.R. Palmer, Board Practice, March 1965.

Footnotes:

- nil

TABLE 15

India: Plywood and Particle Board, End Uses as Estimated Percentages of Total Consumption, 1964-65

		Plywood		Particle Board		
				Flat pressed	Extruded	
	a	b	c	d	e	f
		%	cu. m.	%	%	cu. m.
1	Furniture	3.0	2,900	39.5	28.0	...
2	Movable	...	...	26.5	21.0	...
3	Built-in	...	...	13.0	7.0	...
4	Construction	28.5	27,590	44.0	69.0	...
5	Doors	...	...	5.0	57.0	...
6	Flooring	...	...	5.0	...	...
7	Floor underlayment	...	...	...	...	...
8	Ceilings	...	...	7.5	...	...
9	Roof Underlayment	...	...	...	...	...
10	Walls partition	...	...	26.5	12.0	...
11	Concrete Formwork	...	...	...	...	...
12	Transport	17.0	16,460	15	-	-
13	Other	51.5	49,850	1.5	3	...
14	Total	100.0	96,800	100.0	100.0	(9,440)(1)

Sources:

Enquiry into Use Patterns ... Wood Based Panels
FAO Committee on Wood Based Panel Products Second Session, Rome, November, 1968
FO: WPP/68/7.4

Footnotes:
... Figures not available
( ) Estimate
- Nil or negligible
Subtotal
- - -

(1) 5,900 metric tons x 1.6 (FAO conversion factor)

TABLE 16

India: Estimated per Caput and Total Consumption of Sawn-wood and Plywood, Estimated per Caput Income

Year	Estimated per 1,000 capita consumption[A]		Estimated mid-[B] year population	Estimated total consumption		Estimated per caput net national income at 1960-61 prices	
	Sawnwood m^3	Plywood m^3	thousands	Sawnwood[1] '000 m^3	Plywood[2] '000 m^3	NCAER[C] rupees	Official[D] rupees
	a	b	c	d	e	f	g
1955 1955-56	3	0.1	386,621	1,160	39	307.6	-
1960 1960-61	3	0.2	429,027	1,287	86	336.3	326
1965 1965-66	3	0.2	(483,037)	1,449	97	-	325

SOURCES:

(A) 1968 Yearbook of Forests Products, FAO

(B) Demographic Yearbook, 1965, UN

(C) Estimates of State Income, NCAER, India, 1967

(D) Fourth Five Year Plan. A Draft Outline, India, 1966

FOOTNOTES:

- nil, ( ) estimated figure

(1) These figures do not conflict with the estimates for total timber output on page 18 of text, which apparently (and according to the FAO) refer to roundwood or wood prior to primary processing including sawlogs, veneer logs, sleepers and pit props.

(2) Plywood here includes both tea chest and commercial plywood.

TABLE 17

Site 1: Andhra Pradesh : Single-shift operation, Cash flow discounted. Plant efficiency = 86%, Selling price = Rs. 1.40 per sq. ft.

Year	Investment		Allowances for Tax		Tax saved	Profit	Income Tax	Net Cash Outflow	Net Cash Inflow	Discounted at 6 per cent			Discounted at 7 per cent			Year
	Buildings, Plant and Commission and Unforeseens, with import duty @ 27½%	Working Capital	Tax holiday income	Depreciation on building and plant	55% x c+d	before Depreciation	on f at 55%	a+b	e+f-g	Discount factor	Outflow hxj	Inflow ixj	Discount factor	Outflow hxm	Inflow ixm	
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	
0	3,013,230							3,013,230		1.000	3,013,230		1.000	3,013,230		0
1		149,150	154,044	249,198	221,783	350,954		149,150	572,737	.943	140,648	540,091	.935	139,455	535,509	1
2			142,693	224,278	201,834	421,145	193,025		429,954	.890		382,659	.873		375,350	2
3			130,582	201,850	182,838	421,145	231,630		372,353	.840		312,777	.816		303,840	3
4			119,682	181,665	165,741	421,145	231,630		355,256	.792		281,363	.763		271,060	4
5			109,873	163,498	150,354	421,145	231,630		339,869	.747		253,882	.713		242,327	5
6				147,149	80,932	421,145	231,630		270,447	.705		190,665	.666		180,118	6
7				132,434	72,839	421,145	231,630		262,354	.665		174,465	.623		163,447	7
8				119,190	65,554	421,145	231,630		255,069	.627		159,928	.582		148,450	8
9				107,271	58,999	421,145	231,630		248,514	.592		147,120	.544		135,192	9
10				96,544	53,099	421,145	231,630		242,614	.558		135,379	.508		123,248	10
11				86,890	47,790	421,145	231,630		237,305	.527		125,060	.475		112,720	11
12				78,201	43,011	421,145	231,630		232,526	.497		115,565	.444		103,242	12
13				70,381	38,710	421,145	231,630		228,225	.469		107,038	.415		94,713	13
14				63,342	34,838	421,145	231,630		224,353	.442		99,164	.388		87,049	14
15	-141,810[1]	-149,150[2]		57,009	31,355	421,145	231,630		511,830[4]	.417		213,433	.362		185,282	15
16				371,266[3]	204,196		231,630		-27,434	.394		-10,809	.339		-9,300	16
											3,153,878	3,227,780		3,152,685	3,052,247	
												$\frac{\Sigma k}{\Sigma l}$=0.977			$\frac{\Sigma n}{\Sigma o}$=1.033	

SOURCES re method:- a) "Taxes and Incentives: a guide for investors" pub. Indian Investment Centre, New Delhi, June 1968.

b) "Discounted Cash Flow; principles and some short cut techniques", by A M Alfred and J B Evans, 2nd ed., pub. Chapman and Hall, reprinted 1967.

FOOTNOTES:- 1. Scrap value of plant (5% of initial value (Table 20, row 1, col. d.)) plus residual value of building.

2. Working Capital assumed to be recovered

3. Written-down value of plant at the end of year 15 (Table 20, col. f.) less the scrap value

4. Columns e + f - g - (a + b)

TABLE 18

Site 1: Andhra Pradesh : Single-shift operation, Cash flow discounted. Plant efficiency = 70%. Selling price = Rs. 1.40/sq. ft.

Year	Investment		Allowances for Tax		Tax saved	Profit	Income Tax	Net Cash Outflow	Net Cash Inflow	Discounted at 3 per cent			Discounted at 4 per cent			Year
	Buildings, Plant and Commission and Unforeseens, with import duty @ 27½%	Working Capital	Tax holiday income	Depreciation on buildings and plant	55% x c+d	before Depreciation	on f at 55%	a+b	e+f-g	Discount factor	Outflow hxj	Inflow ixj	Discount factor	Outflow hxm	Inflow ixm	
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	
0	3,013,230							3,013,230		1.000	3,013,230		1.000	3,013,230		0
1		126,367	149,797	249,198	219,447	254,948		126,367	474,395	.971	122,702	460,638	.962	121,565	456,368	1
2			137,870	224,278	199,181	305,937	140,221		364,897	.943		344,098	.925		337,530	2
3			125,759	201,850	180,185	305,937	168,265		317,857	.915		290,839	.889		282,575	3
4			114,859	181,665	163,088	305,937	168,265		300,760	.888		267,075	.855		257.150	4
5			105,049	163,498	147,701	305,937	168,265		285,373	.863		246,277	.822		234,577	5
6				147,149	80,932	305,937	168,265		218,604	.837		182,972	.790		172,697	6
7				132,434	72,839	305,937	168,265		210,511	.813		171,145	.760		159,988	7
8				119,190	65,554	305,937	168,265		203,226	.789		160,345	.731		148,558	8
9				107,271	58,999	305,937	168,265		196,671	.766		150,650	.703		138,260	9
10				96,544	53,099	305,937	168,265		190,771	.744		141,934	.676		128,961	10
12				86,890	47,790	305,937	168,265		185,462	.722		133,904	.650		120,550	11
12				78,201	43,011	305,937	168,265		180,683	.701		126,659	.625		112,927	12
13				70,381	38,710	305,937	168,265		176,382	.681		120,116	.601		106,006	13
14				63,342	34,838	305,937	168,265		172,510	.661		114,029	.577		99,538	14
15	-141,810[1]	-126,367[2]		57,009	31,355	305,937	168,265		437,204[4]	.642		280,685	.555		242,648	15
16				371,266[3]	204,196		168,265		35,931	.623		22,385	.534		19,187	16
											3,135,932	3,213,751		3,134,795	3,017,520	
												$\frac{\Sigma k}{\Sigma l}$=.976			$\frac{\Sigma n}{\Sigma o}$=1.039	

SOURCES re method:- a) "Taxes and Incentives: a guide for investors" pub. Indian Investment Centre, New Delhi, June 1968.

b) "Discounted Cash Flow; principles and some short cut techniques", by A M Alfred and J B Evans, 2nd ed., pub. Chapman and Hall, reprinted 1967

FOOTNOTES:- 1. Scrap value of plant (5% of initial value (Table 20, row 1, col. d.)) plus residual value of building.

2. Working Capital assumed to be recovered

3. Written-down value of plant at the end of year 15 (Table 20, col. f.) less the scrap value.

4. Columns e + f - g - (a + b)

TABLE 19

Site 1: Andhra Pradesh: Double-shift operation, cash flow discounted. Plant efficiency = 70% Selling price = Rs. 1.40/sq. yd.

Year	Investment		Allowances for Tax		Tax saved	Profit	Income Tax	Net Cash Outflow	Net Cash Inflow	Discounted at 14 per cent			Discounted at 15 per cent			Year
	Buildings, Plant and Commission and Unforeseens, with import Duty @ 27½%	Working Capital	Tax holiday income	Depreciation on buildings and plant	55% x c+d	before Depreciation	on f at 55%	a+b	e+f-g	Discount factor	Outflow	Inflow	Discount factor	Outflow	Inflow	
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	
0	3,013,230							3,013,230		1.000	3,013,230		1.000	3,013,230		0
1		240,545	159,849	368,276	290,469	599,797		240,545	890,266	.877	210,958	780,763	.870	209,274	774,531	1
2			144,632	313,587	252,020	719,756	329,888		641,888	.769		493,611	.756		485,267	2
3			128,609	267,045	217,610	919,756	395,866		541,500	.675		365,512	.658		356,307	3
4			114,963	227,436	188,319	719,756	395,866		512,209	.592		303,228	.572		292,984	4
5			103,340	193,723	163,385	719,756	395,866		487,275	.519		252,896	.497		242,176	5
6				165,027	90,765	719,756	395,866		414,655	.456		189,083	.432		179,131	6
7				140,599	77,329	719,756	395,866		401,219	.400		160,488	.376		150,858	7
8				119,802	65,891	719,756	395,866		389,781	.351		136,813	.327		127,458	8
9				102,095	56,152	719,756	395,866		380,042	.308		117,053	.284		107,932	9
10				87,019	47,860	719,756	395,866		371,750	.270		100,372	.247		91,822	10
11				74,181	40,800	719,756	395,866		364,690	.237		86,431	.215		78,408	11
12				63,246	34,785	719,756	395,866		358,675	.208		74,604	.187		67,072	12
13				53,932	29,663	719,756	395,866		353,553	.182		64,347	.163		57,629	13
14				45,998	25,299	719,756	395,866		349,189	.160		55,870	.141		49,236	14
15	-141,810[1]	-240,545[2]		39,239	21,581	719,756	395,866		727,826[4]	.140		101,896	.123		89,523	15
16				88,961[3]	48,929		395,866		-346,937	.123		-42,673	.107		-37,122	16
											3,224,188	3,240,294		3,222,504	3,113,212	
												$\frac{\Sigma k}{\Sigma l}$=0.995			$\frac{\Sigma n}{\Sigma o}$=1.035	

SOURCES re method:- a) "Taxes and Incentives: a guide for investors" pub. Indian Investment Centre, New Delhi, June 1968

b) "Discounted Cash Flow: principles and some short cut techniques," by A M Alfred and J B Evans, 2nd ed., pub. Chapman and Hall, reprinted 1967

FOOTNOTES:

1. Scrap value of plant (5% of initial value (Table 20, row 1, col. d)) plus residual value of building
2. Working capital assumed to be recovered
3. Written-down value of plant at end of year 15 (Table 20, col. f) less the scrap value
4. Columns e + f - g - (a+b)

TABLE 20

Calculation of Allowances: Tax holiday income and depreciation

SITE 1: Andhra Pradesh: Single-shift operation, Cash flow, discounted. Plant efficiency = 86% Selling price = Rs. 1.40 per sq.ft.

Year	Buildings			Plant			Total fixed assets at end of year cols. c + f	Estimated working capital	Half Profits	Estimated Capital for tax holiday g + h + i	Amount exempt from tax 6% of col. j	Depreciation col. b + e
	Value of asset at start of year	Depreciation at 10%	Written-down value of asset at end of year	Value of asset at start of year[1]	Depreciation at 10%	Written-down value of asset at end of year						
	a	b	c	d	e	f	g	h	i	j	k	l
1	110,400	11,040	99,360	2,381,576	238,158	2,143,418	2,242,778	149,150	175,477	2,567,405	154,044	249,198
2	99,360	9,936	89,424	2,143,418	214,342	1,929,076	2,018,500	149,150	210,572	2,378,222	142,693	224,278
3	89,424	8,942	80,482	1,929,076	192,908	1,736,168	1,816,650	149,150	210,572	2,176,372	130,582	201,850
4	80,482	8,048	72,434	1,736,168	173,617	1,562,551	1,634,985	149,150	210,572	1,994,707	119,682	181,665
5	72,434	7,243	65,191	1,562,551	156,255	1,406,296	1,471,487	149,150	210,572	1,831,209	109,873	163,498
6	65,191	6,519	58,672	1,406,296	140,630	1,265,666						147,149
7	58,672	5,867	52,805	1,265,666	126,567	1,139,099						132,434
8	52,805	5,280	47,525	1,139,099	113,910	1,025,189						119,190
9	47,525	4,752	42,773	1,025,189	102,519	922,670						107,271
10	42,773	4,277	38,496	922,670	92,267	830,403						96,544
11	38,496	3,850	34,646	830,403	83,040	747,363						86,890
12	34,646	3,465	31,181	747,363	74,736	672,627						78,201
13	31,181	3,118	28,063	672,627	67,263	605,364						70,381
14	28,063	2,806	25,257	605,364	60,536	544,828						63,342
15	25,257	2,526	22,731	544,828	54,483	490,345						57,009
16				490,345	49,034	441,311						

Sources: a) Tables 3, 7 and 22
b) "Taxes and Incentives. a guide for investors" pub. Indian Investment Centre, New Delhi, June 1968.

Footnote: (1) Value of plant and equipment, excluding boiler, but including import duty at 27½%. (N B. Resin - captive - plant cost also included; see table 21).

TABLE 21

Calculation of allowances: Tax holiday income and depreciation

Site 1:' Andhra Pradesh: Double-shift operation, cash flow discounted. Plant efficiency = 70%, selling price = Rs. 1.40 sq.ft.

Year	Buildings			Plant			Total fixed assets at end of year c + f	Estimated working capital	Half Profits	Estimated Capital for tax holiday g + h + i	Amount exempt from tax 6% of col. j	Depreciation col. b + e
	Value of asset at start of year	Depreciation at 10%	Written-down value of asset at end of year	Value of asset at start of year[1]	Depreciation at 15%	Written-down value of asset at end of year						
	a	b	c	d	e	f	g	h	i	j	k	l
1	110,400	11.040	99,360	2,381,576	357,236	2,024,340	2,123,700	240,545	299,898	2,664,143	159,849	368,276
2	99,360	9,936	89,424	2,024,340	303,651	1,720,689	1,810,113	240,545	359,878	2,410,536	144,632	313,587
3	89,424	8,942	80,482	1,720,689	258,103	1,462,586	1,543,068	240,545	359,878	2,143,491	128,609	267,045
4	80,482	8,048	72,434	1,462,586	219,388	1,243,198	1,315,632	240,545	359,878	1,916,055	114,963	227,436
5	72,434	7,243	65,191	1,243,198	186,480	1,056,718	1,121,909	240,545	359,878	1,722,332	103,340	193,723
6	65,191	6,519	58,672	1,056,718	158,508	898,210						165,027
7	58,672	5,867	52,805	898,210	134,732	763,478						140,599
8	52,805	5,280	47,525	763,478	114,522	648,956						119,802
9	47,525	4,752	42,773	648,956	97,343	551,613						102,095
10	42,773	4,277	38,496	551,613	82,742	468,871						87,019
11	38,496	3,850	34,646	468,871	70,331	398,540						74,181
12	34,646	3,465	31,181	398,540	59,781	338,759						63,246
13	31,181	3,118	28,063	338,759	50,814	287,945						53,932
14	28,063	2,806	25,257	287,945	43,192	244,753						45,998
15	25,257	2,526	22,731	244,753	36,713	208,040						39,239
16				208.040	31,206	176,834						

SOURCES: a) Tables 3, 8 (costs adjusted for double-shift working) and 22
b) "Taxes and Incentives: a guide for investors"
pub. Indian Investment Centre, New Delhi, June 1968.

FOOTNOTE: (1 Value of plant and equipment, excluding boiler, but including import duty at 27½%. (N.P. Resin captive plant cost also included - see table 22)

TABLE 22

Site 1 Andhra Pradesh:

Cost structure of captive plant to make UF resin, 1.150 metric tons per day on 3 shifts
0.383 metric tons per day on 1 shift

Output per year of 300/3 shifts 344.9 metric tons
300/1 shift 115.0 metric tons

Solids content of resin 46 per cent

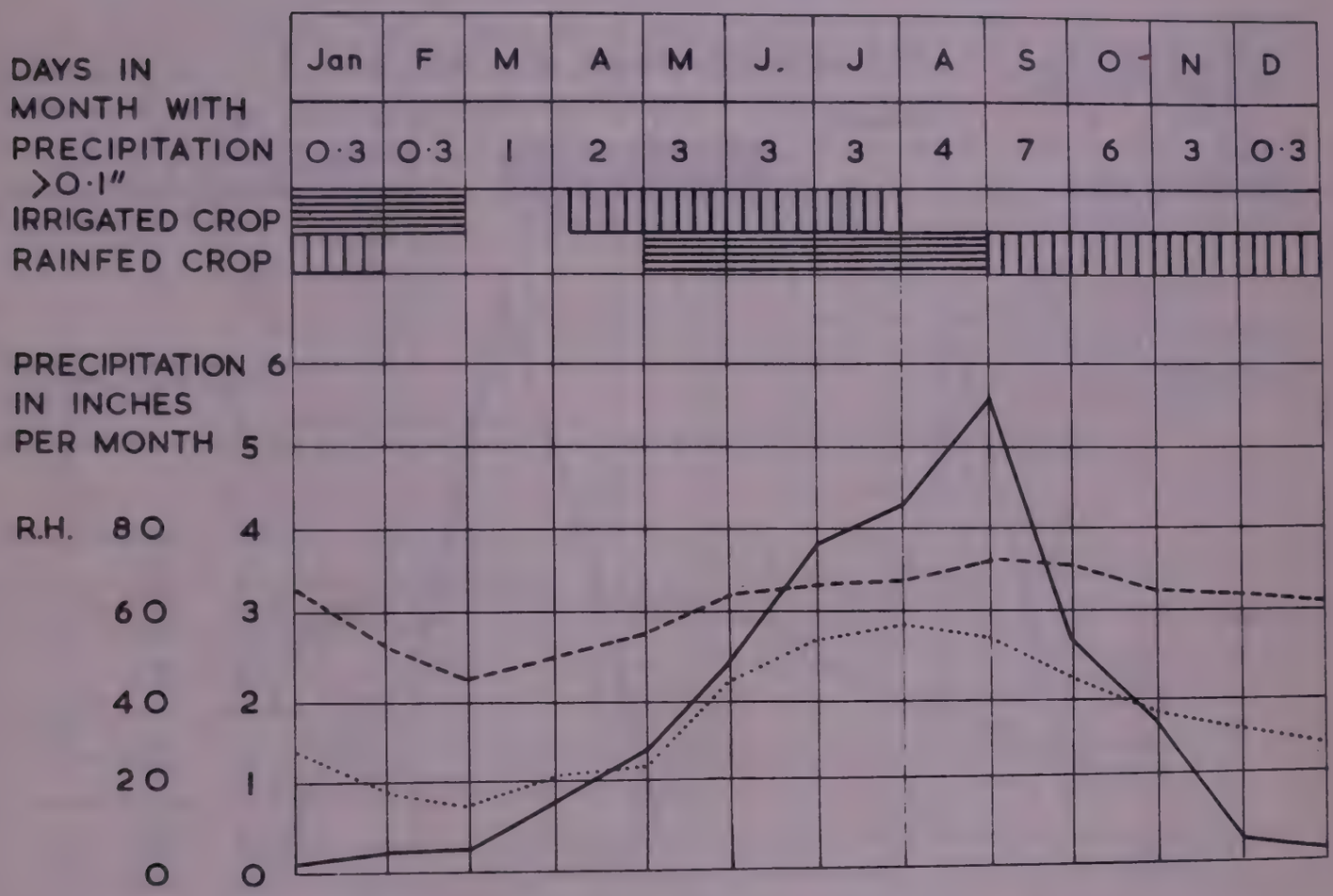
	Item	Quantity or number	Costs, Rupees, all items bought in India 3 shifts	1 shift	Prices or Rates	Remarks
	a	b	c	d	e	f
	Capital Costs					
1	Steam jacketed mild steel(1) vessel, 1,000 litres Stirrer 2½ H.P.	1) 1)	15,660	15,660		As quoted by English firm assumed to equal price for items made in India
2	Plus 10% for unforeseens		17,226	17,226		
	Operating Costs **Raw Materials**					
3	Urea	176.7 tons	156,026	-	Rs 883 per ton, including all charges	
4	"	58.9 tons	-	52,009		
5	Formaldehyde	591.6 tons	897,694	-	Rs 1,380 per ton, plus rail freight	
6	30% solution w/w	197.3 tons	-	299,383		
7	Total "		1,053,720	351,392		
	Personnel					
8	Skilled operative	3	18,000		Rs 500 per month	
9	" "	1		6,000		
	Services					
10	Electricity Energy charge	3,870 kWh	348	-	Rs 0.09 per unit	
11	" " "	1,290 kWh	-	116	"	
12	Steam	400.6 tons	4,707	-	Rs 11.75 per ton	
13	"	133.5 tons	-	1,569	"	
14	Total		5,055	1,685		
	Other Costs					
15	Insurance Plant		70	70	0.45% on value of plant	Based on row 1
16	Repairs and Maintenance		470	470	3% of plant cost	Based on row 1
17	Total		540	540		
	Depreciation					
18	Machinery		1,566	1,566(2)	10% or $6^2/3$% on initial value	
	Total Plant Cost		1,078,881	361,183		
	Cost per metric ton		3,128	3,141		
	Plus excise duty		4,254	4,272	36% on plant cost	

Footnotes:

(1) The equipment is assumed to be purchased in India.
(2) Erratum. This figure should have been 1,044. The error does not affect the final result.

FIGURE 1.

ANDHRA PRADESH—SITE 1.: CLIMATE AND CROP DATA



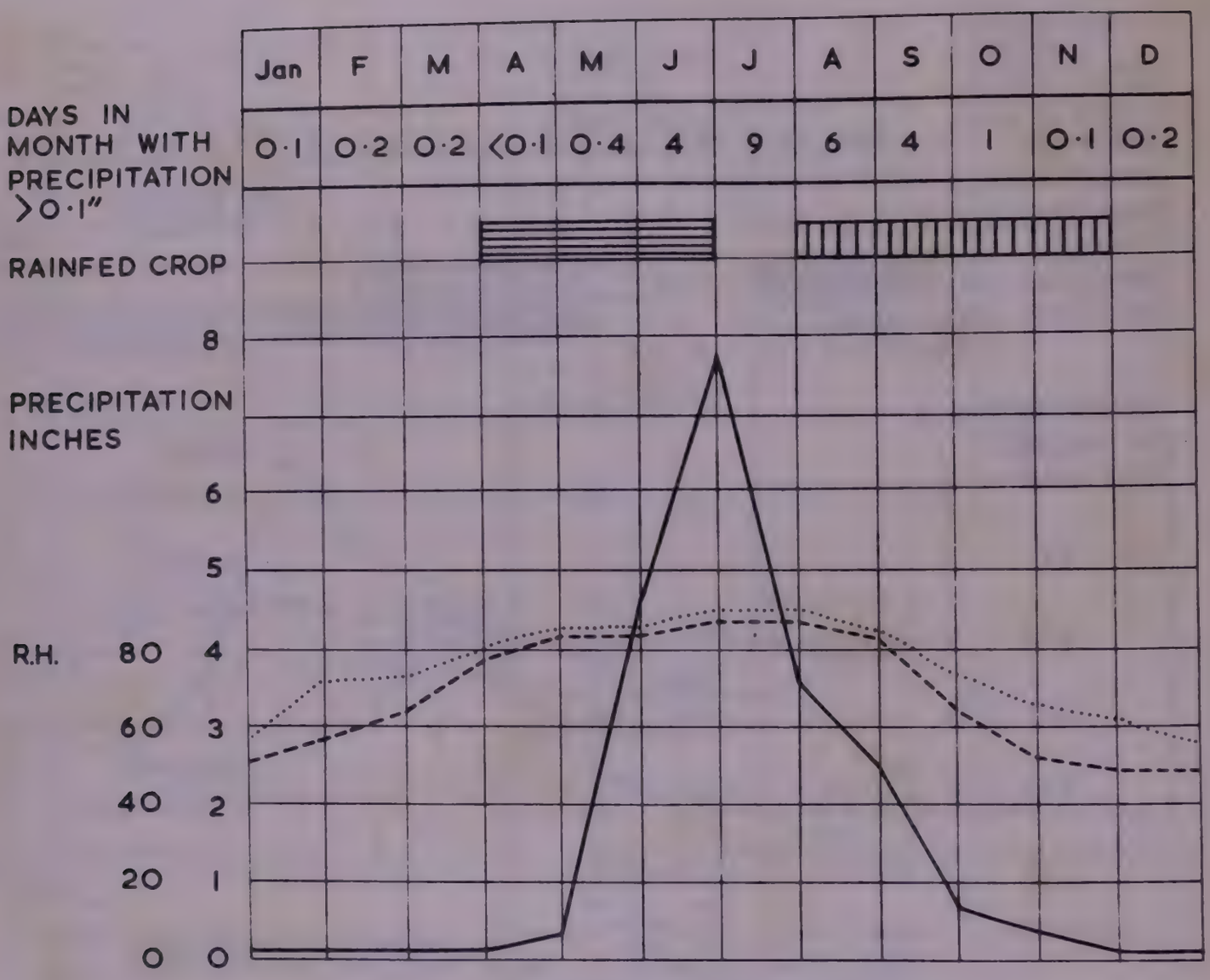
SOURCES: METEOROLOGICAL OFFICE. TABLES OF TEMPERATURE, RELATIVE HUMIDITY AND PRECIPITATION FOR THE WORLD. H.M.S.O. 1958 (REPRINT 1965)
PRECIPITATION AT KURNOOL FROM FACTORY SITE.
OTHER METEOROLOGICAL DATA FROM BELLARY.
'GROUNDNUT' C.R.SESHADRI. EXAMINER PRESS, BOMBAY. 1962.

KEY:

- RAINFALL INCHES PER MONTH.
- RELATIVE HUMIDITY AT 0800 HOURS.
- RELATIVE HUMIDITY AT 1600 HOURS.
- SOWING MONTHS.
- HARVESTING MONTHS.

FIGURE 2.

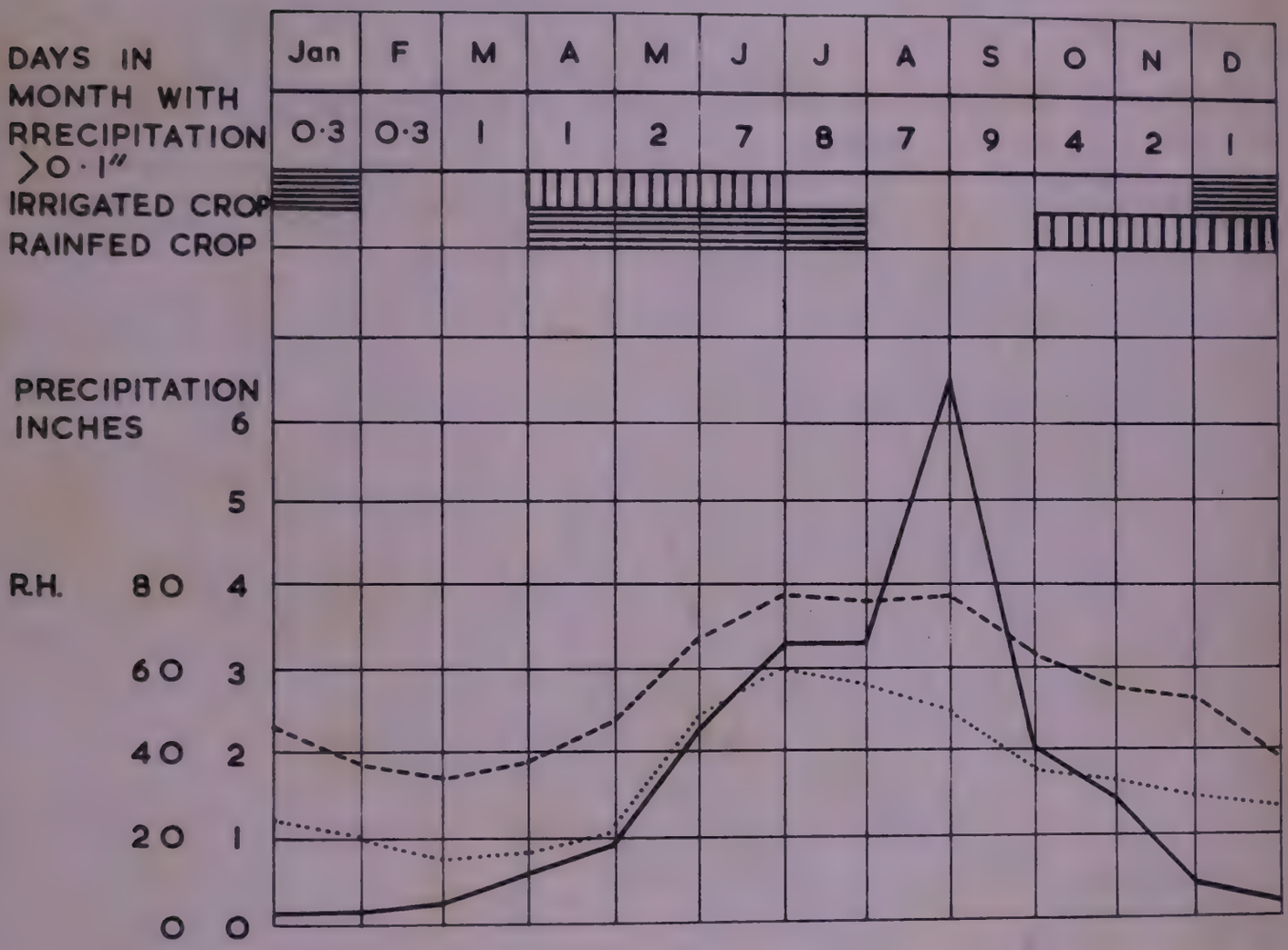
GUJARAT.—SITE 4. : CLIMATE AND CROP DATA



METEOROLOGICAL DATA FROM VERAVAL

FIGURE 3.

MAHARASHTRA.—SITE 6. : CLIMATE AND CROP DATA



METEOROLOGICAL DATA FROM SHOLAPUR